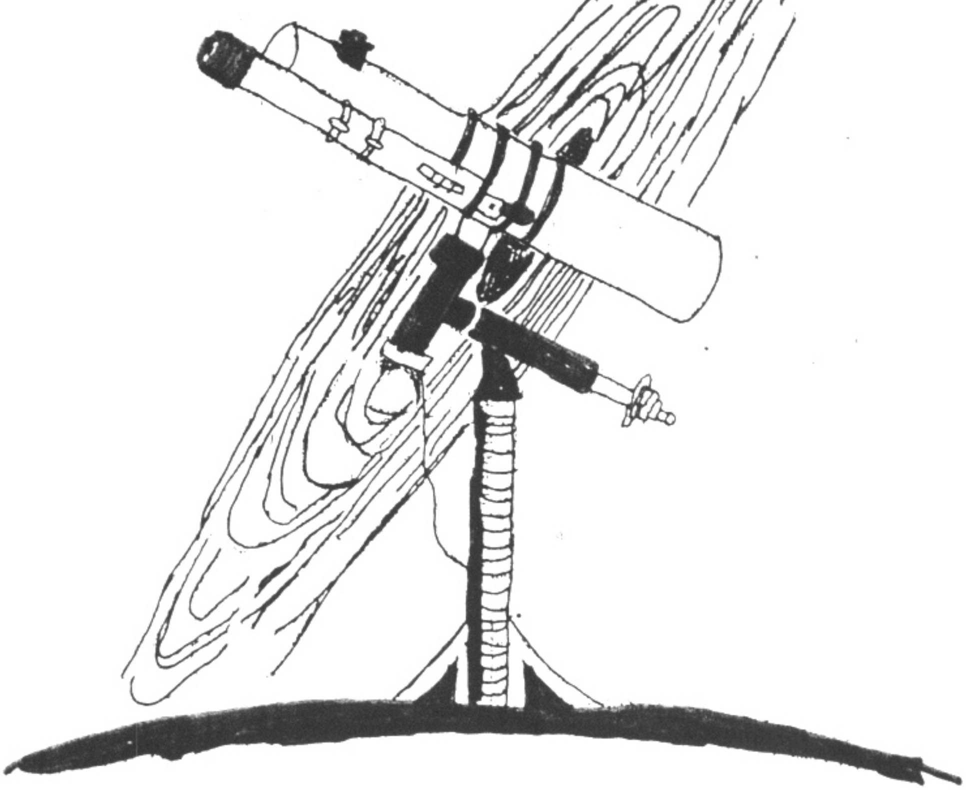
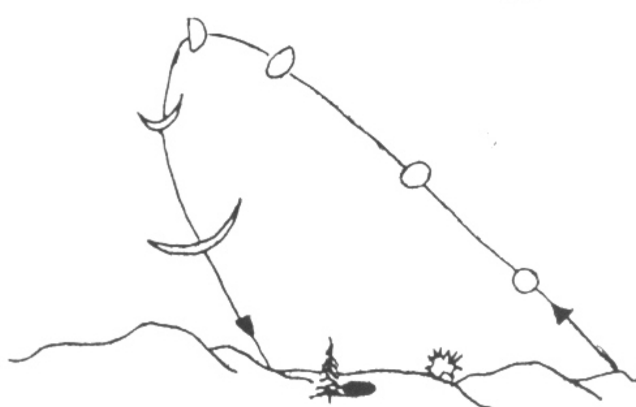
# PETERBOROUGH ASTRONOMICAL ASSOCIATION



## News Letter Vol. 1



TELEPHONE NUMBERS

of

MORE REGULAR MEMBERS

| Name | Number |
|---|---|
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| Bob Fydell | 743-7241 |
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| Richard Milligan | 742-3664 |
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| Mr. Toop | 745-5110 |
| Jeffery Toop | 745-5110 |
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ASTRONOMY BOOKS

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(Unless otherwise indicated all books are paperback editions)

| Price | Publisher Code | Title & Description |
|---|---|---|
| 5.95 | TAA | Around the World - A View From Space -- 96 of the most interesting photographs taken by astronauts in space. Each of them is pinpointed on a full colour global view with a description. Hardcover. |
| 5.00 | PPP | Atom to Andromeda - Based on the 1966 Nuclear Research Foundation Summer Science school. The writing is at a level that general readers can understand. Treatment is descriptive, dealing with cosmic rays, light from the stars, radio waves, plasma physics, computers. Hardcover. |
| 6.00 | STA | Between The Planets - An up-to-date account of the smaller bodies in our solar system; Comets, meteors, asteroids. Hardcover. |
| 9.00 | STA | Beyond the Milky Way - Galaxies, quasars and the new cosmology. Topics covered are distances beyond the Milky Way, structure and content of the galaxies, quasars, masses and luminosity, cosmology. Hardcover. |

cont.

| Price | Publisher Code | Title & Description |
|---|---|---|
| 8.50 | STA | Earth, Moon and Planets -- An introduction to the planets and their satellites. Hardcover |
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| 6.00 | STA | Galaxies -- About the research into the nature of the universe. How do we determine distance, structure and constitution. The place of the Milky Way among the galaxies. Hardcover. |
| 3.00 | STA | How to become an astronomer -- Necessary qualification, professional standing, demand, advancement, and related astronomical occupation. |

BOOKS PRESENTLY CONTAINED
in the
ASTRONOMY CLUB'S LIBRARY

| Code | Title | Name |
|---|---|---|
| S3 | Search for Life in Other Worlds | Dave Sheard |
| C5 | Constellations | " |
| F1 | Field Guide to the Stars and planets | " |
| H1 | Handbook of the Heavens | " |
| U1 | UFO's over the Americas | " |
| T11 | Truths about UFO's | " |
| S6 | Startling Evidence of an Invasion from Outer Space | " |
| M1 | Mathematics for Space Exploration | " |
| S4 | Stars | " |
| S5 | Stars | " |
| S1 | Satellites in the Solar System | " |
| T5 | The Moon | " |
| R3 | Rockets and Missiles | " |
| M3 | Model Rocketry | " |
| U3 | Universal Math Encyclopedia | " |
| J1 | Journals | " |
| C3 | Concise Encyclopedia of Astronomy | Richard Milligan |
| I3 | Introduction to Astronomy | " |
| A3 | An Introduction of Astronomy | " |
| S8 | Survey of the Moon | " |
| P2 | Popular Star Atlas | " |
| U2 | UFO's the Whole Story | " |
| U6 | Universe | " |
| R1 | Radio Astronomy | " |
| C6 | Creation of the Universe | " |
| P1 | Plane Trigonometry | " |
| T6 | The New Physics | " |
| I2 | Intelligent Life in the Universe | Percy Gill |
| T1 | The Double Planet | " |

| Code | Title | Name |
|---|---|---|
| T7 | Theories of the Universe | Percy Gill |
| S2 | Scientific Study of UFO's | " |
| F4 | Flying Saucers - Serious Business | " |
| F3 | Flying Saucers | " |
| W1 | Worlds in Collision | " |
| T9 | The Universe and Dr. Einstein | " |
| A7 | Astronomy | " |
| M2 | The McLaughlin Planetarium | Dean Shewring |
| N1 | New Handbook of the Heavens | " |
| V1 | Voice from the Sky | " |
| P3 | Penguin Dictionary of Astronomy | " |
| C1 | Chariots of the Gods? | " |
| G4 | Gods from Outer Space | " |
| U4 | UFO's? Yes! | " |
| M4 | Mysterious Finds and Lights | " |
| T2 | The Telescope and Astronomy | " |
| W4 | Worlds in Collision | " |
| A5 | Astronomy Made Simple | " |
| U5 | The Universe - From Flat Earth to Quasars | " |
| S7 | Sky and Telescope - Oct. 1969 to present | " |
| A70 | Astronomy | Frank Scheibenpflug |
| L1 | Larouse Encyclopedia of Astronomy | " |
| I6 | Exploration of the Universe | " |
| L2 | Elementary Astronomy | " |
| S10 | Starlight - What it tells about the stars | " |
| S11 | Stars and Clouds of the Milky Way | " |
| A15 | The Amateur Astronomer | " |
| O4 | Outer Space Photography | " |
| M5 | Mechanics of the Solar System | " |
| F7 | The Fascinating World of Astronomy | " |
| F8 | Frontiers of Astronomy | " |
| S20 | Sky shooting Photography for the Amateur | " |

| Code | Title | Name |
| --- | --- | --- |
| C10 | Celestial Objects for Common Telescopes vol. 1—2 | Frank Scheibenpflug |
| W40 | World of Stars and Planets | " |
| W7 | The Universe of Space | " |
| S21 | The Structure of the Universe | " |
| C2 | The Creation of the Universe | " |
| S9 | The Sky Observer's Guide | " |
| W2 | The Watershed Biography of Johannes Kepler | " |
| U7 | The Universe of Light | " |
| H4 | How to Become an Astronomer | " |
| C2 | The Cosmological Argument | " |
| R4 | Relativity and Albert Einstein | " |
| N4 | The Nature of the Universe | Dean Shewring |

# THE ORION NEBULA

Geoffrey Toop

The Orion Nebula, although barely visible to the naked eye, is easily seen through binoculars as the middle star in Orion's belt. It is composed of interstellar gas and dust. The gas contains 75% Hydrogen, 22% Helium and 3% other gases by mass. Most of the gas is cold and non-luminous (H I -- neutral). However near hot stars, the gas is ionized by the ultraviolet radiation from these stars (H II -- ionized). The gas in the H II regions glows by the process of fluorescence. The light emitted consists largely of emission lines so the nebula is classified as an emission nebulae with a density of $10^3$ or $10^4$ atoms per cubic centimeter.

All ultraviolet radiation of wavelength 912 Å or less can be absorbed by the neutral hydrogen, which in doing so is ionized.
The hottest stars emit an appreciable fraction of energy in wavelengths less than 912 Å. If such a star is surrounded by interstellar gas, the gas atoms are ionized and become free electrons and ions. When an ion captures an electron, light is produced. Another ultraviolet photon collides with the atom freeing the electron and beginning the cycle again. At any given time almost all the gas is ionized. Clouds of dust in the nebula hide a large part of the H II region from our view.

Radio radiation is also emitted by H II regions, An electron passing near an ionized atom can change from its hyperbolic orbit to another hyperbola, emitting or absorbing in the process a photon on a definite wavelength. The many-many photons of different wavelengths comprise continuous radiation, a good part of which lies in the radio part of the spectrum.

# SOLAR ECLIPSE REPORT

A Brief Report Presented
by the
P.A.A. Expedition to Quebec

Departure Time ------------------------- 4 a.m. July 2
Arrival Time -------------------------- 3 p.m. July 3
Total Traveling Time ------------------------ 18 hours
Total Mileage Driven ----------------------- 798 miles

— Chose a spot 1200 ft. above sea level (as indicated by a 3—D model of the area at the Public Relations Office.)

— Latitude and longitude of area +50 30.0 N lat.
68 50.0 W long.

— Located our camp beside French astronomers, headed by Dr. M.J. Laffineur of the Pic-du-Midi Institute of Astro—Physics

— On day of eclipse whole area was heavily fogged

— Later lifted, then became overcast

— At time of eclipse thin cloud areas were prominent so that partial seeing was permitted

| | |
|---|---|
| — 1st contact | 19h 18m 5.0s U.T. |
| — 2nd contact | 20h 25m 15.8s U.T. |
| — Midpt. of totality | 20h 26m 26.2s U.T. |
| — 3rd contact | 20h 27m 36.5s U.T. |
| — 4th contact | 21h 29m 34.4s U.T. |

— At mid—totality the sun held a position of:

38° altitude
259° azimuth

— The magnitude of the eclipse was 1.037

— Width of the band of totality was 113 miles

# THE ASTRONOMER

The Astronomer works every night,
As he watches the dim star light;
He photographs the stars in the sky
And plots the meteors as they pass by.

His fame is seldom known;
To his own kind his work is shown.
The public seldom knows his name,
But his kind knows his fame.

If he is lucky, his name will appear
Somewhere, where Tychos' is near.
He always stays with his kind
Because the public will pay him no mind.

But our nocturnal Friend
knows he has succeeded in the end.

by Richard Milligan.

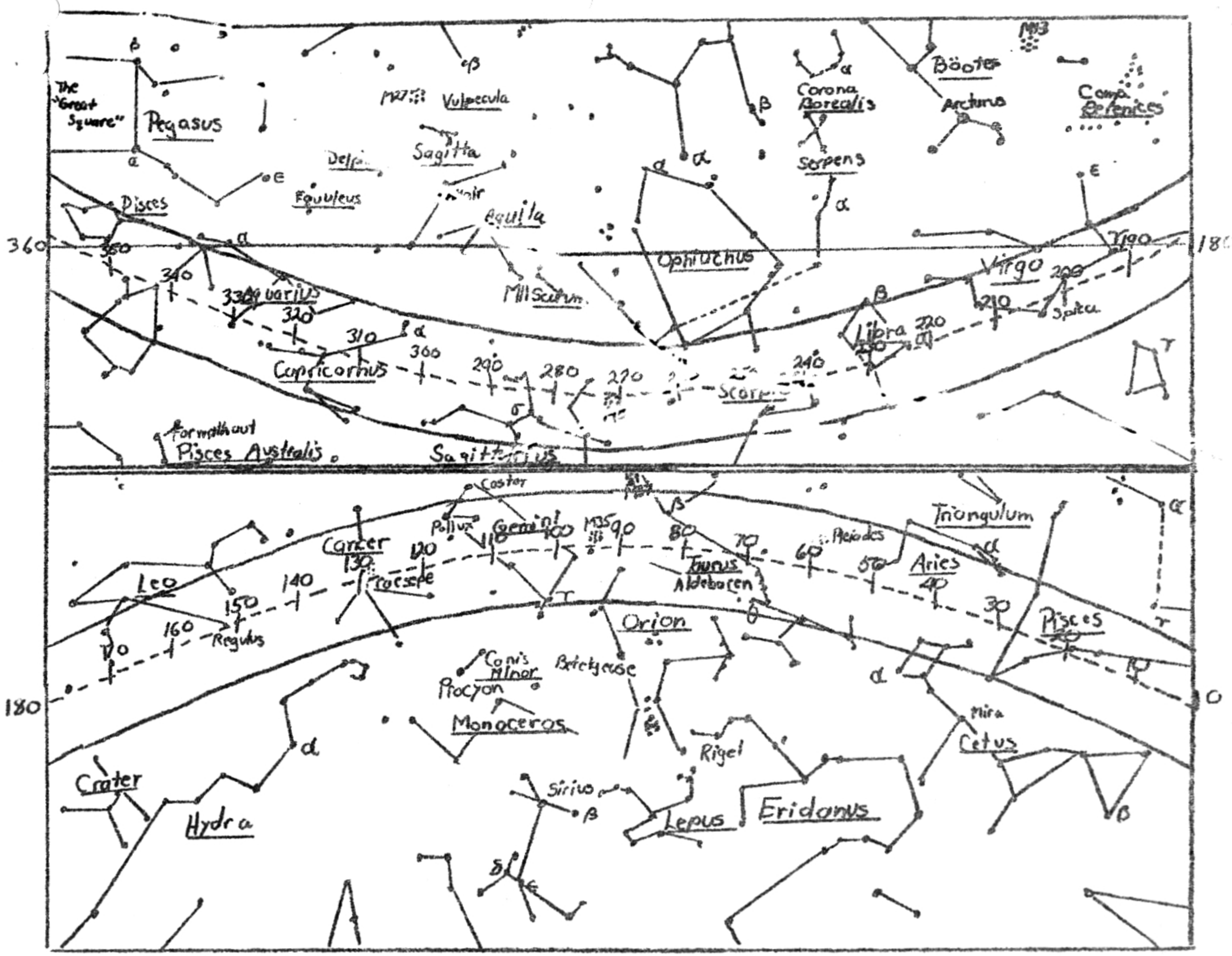
POSITIONS of the PLANETS for the end of 1972
and
for the YEAR 1973
*( J,D, — J.D.+2440000 )

| YEAR | DATE | JD | SUN | MER | VEN | MAR | JUP | SAT |
|---|---|---|---|---|---|---|---|---|
| 1972 | Nov 8 | 1630 | 226 | 249 | 190 | 205 | 276 | 80 |
| " | Nov 18 | 1640 | 236 | 253 | 202 | 212 | 278 | 79 |
| " | Nov 28 | 1650 | 246 | 241 | 214 | 213 | 280 | 78 |
| " | Dec 8 | 1660 | 257 | 237 | 227 | 225 | 282 | 77 |
| " | Dec 18 | 1670 | 267 | 246 | 339 | 232 | 284 | 76 |
| " | Dec 28 | 1680 | 277 | 259 | 252 | 238 | 287 | 75 |
| 1973 | Jan 7 | 1690 | 287 | 274 | 264 | 245 | 289 | 74 |
| " | Jan 17 | 1700 | 297 | 290 | 277 | 252 | 291 | 73 |
| " | Jan 28 | 1710 | 307 | 306 | 289 | 259 | 294 | 73 |
| " | Feb 6 | 1720 | 317 | 336 | 302 | 266 | 296 | 73 |
| " | Feb 16 | 1730 | 326 | 343 | 315 | 273 | 298 | 73 |
| " | Feb 26 | 1740 | 337 | 356 | 327 | 280 | 300 | 73 |
| " | Mar. 8 | 1750 | 348 | 358 | 340 | 287 | 303 | 74 |
| " | Mar 18 | 1760 | 355 | 349 | 352 | 294 | 305 | 74 |
| " | Mar 28 | 1770 | 8 | 347 | 6 | 301 | 306 | 75 |
| " | Apr 7 | 1780 | 17 | 350 | 17 | 308 | 308 | 76 |
| " | Apr 17 | 1790 | 27 | 0 | 29 | 315 | 309 | 77 |
| " | Apr 27 | 1800 | 37 | 14 | 41 | 322 | 310 | 78 |
| " | May 7 | 1810 | 47 | 32 | 54 | 329 | 311 | 79 |
| " | May 17 | 1820 | 56 | 52 | 66 | 336 | 312 | 81 |
| " | May 27 | 1830 | 66 | 75 | 79 | 343 | 312 | 82 |
| " | Jun6 | 1840 | 75 | 94 | 91 | 350 | 312 | 83 |
| " | Jun16 | 1850 | 85 | 109 | 103 | 357 | 312 | 85 |
| " | Jun26 | 1860 | 94 | 119 | 116 | 4 | 312 | 86 |

*J.D. is short for Julian Day, which is a day system proposed by Joseph Scaliger in 1582~. J.D. 1 was on January '1, 4713 B.C. at noon, since the date changes after 12:00 noon.

| YEAR | DATE | JD | SUN | MER | VEN | MAR | JUP | SAT |
|---|---|---|---|---|---|---|---|---|
| 1973 | Jul 6 | 1870 | 104 | 123 | 128 | 10 | 311 | 87 |
| " | Jul 16 | 1880 | 114 | 120 | 140 | 16 | 310 | 89 |
| " | Jul 26 | 1890 | 123 | 113 | 152 | 22 | 308 | 89 |
| " | Aug 5 | 1900 | 133 | 114 | 164 | 28 | 306 | 90 |
| " | Aug 15 | 1910 | 142 | 125 | 176 | 33 | 305 | 92 |
| " | Aug 25 | 1920 | 152 | 143 | 188 | 37 | 304 | 92 |
| " | Sep 4 | 1930 | 162 | 163 | 200 | 39 | 303 | 93 |
| " | Sep 14 | 1940 | 171 | 181 | 211 | 40 | 302 | 94 |
| " | Sep 24 | 1950 | 181 | 198 | 223 | 40 | 302 | 94 |
| " | Oct 4 | 1960 | 191 | 213 | 235 | 38 | 302 | 95 |
| " | Oct 14 | 1970 | 201 | 226 | 246 | 36 | 302 | 95 |
| " | Oct 24 | 1980 | 211 | 235 | 257 | 32 | 303 | 94 |
| " | Nov 3 | 1990 | 221 | 236 | 268 | 27 | 304 | 94 |
| " | Nov 13 | 2000 | 231 | 224 | 278 | 25 | 305 | 94 |
| " | Nov 23 | 2010 | 241 | 222 | 288 | 25 | 306 | 93 |
| " | Dec 3 | 2020 | 251 | 232 | 297 | 25 | 308 | 93 |
| " | Dec 13 | 2030 | 261 | 245 | 304 | 26 | 310 | 92 |
| " | Dec 23 | 2040 | 272 | 262 | 309 | 28 | 312 | 91 |

-for year 1974, expect it in the first issue next year of the PAA Newsletter.



The "Great Square"
Pegasus
Vulpecula
Sagitta
Equuleus
Aquila
Pisces
Aquarius
Capricornus
Ophiuchus
Corona Borealis
Serpens
Böotes
Arcturus
Coma Berenices
Virgo
Spica
Libra
Scorpius
Sagittarius
Pisces Australis
Formalhaut
360
180
Castor
Pollux
Gemini
Cancer
Praesepe
Leo
Regulus
Triangulum
Pleiades
Aries
Taurus
Aldebaran
Orion
Betelgeuse
Rigel
Canis Minor
Procyon
Monoceros
Pisces
Mira
Cetus
Crater
Hydra
Sirius
Lepus
Eridanus

# THEORIES FOR THE FORMATION OF THE ELEMENTS

BOB FYDELL

There are basically two theories for the formation of the elements. One proposes that the majority of the atoms would form from the breakdown of a few or one massive elements. The other suggests that the atoms are formed from the hydrogen atom by neutron-proton collision.

Georges Edward Lemaitre (Belgian, 1894— ) was one of the first astronomers to consider the former theory effectively. He believed that a few massive atoms would break down, producing less massive atoms and so on, progressively, until permanently stable atoms were formed. This, however, would mean a Universe composed chiefly of such stable atoms and massive elements as lead and bismuth. This is not true, there being a preponderance of hydrogen. Therefore Lemaitre's theory in highly unlikely.

The alternate view was best explained by George Gamow (Russian— American, 1904— ) in 1948. According to Gamow's (who believed in the Big Bang) suggestion, the neutronium cosmic egg (the primeval atom associated with the Big Bang, Hyperbolic, and Pulsating theories for the creation of the universe), at the instant of the big bang, disintegrated with ferocious violence into separate neutrons, which rapidly broke down into protons and electrons. Individual neutrons do this today for that matter, the half-life of the breakdown being about thirteen minutes. The protons formed can be considered the nuclei of hydrogen-1 atoms.

As the protons formed, they would sometimes collide with neutrons that still persisted and gradually build up additional stable atomic nuclei of greater complexity. The advantage of this theory is that it makes use of the phenomenon of neutron-addition, something that atoms are prone to do and which can be observed in the laboratory.

If a proton combined with a neutron, for instance, it would form a nucleus of hydrogen-2, or deuterium (one proton/one neutron). Hydrogen-2, combining with another neutron, would form hydrogen-3 or tritium (one proton/ two neutrons). Tritium is, however, unstable. One of the neutrons in its nucleus emits an electron and becomes a proton, and the nucleus becomes helium-3 (two protons/one neutron). The helium-3 nucleus adds a neutron to become the common helium-4 (two protons/two neutrons). The process continues and gradually, one neutron at a time, the whole list of elements is built up.

At the incredibly high temperatures following the explosion of the cosmic egg, Gamow envisages the necessary nuclear reactions to take place very rapidly, even perhaps within the first half-hour. Gradually, thereafter, as the temperatures dropped, the various nuclei would attract electrons to themselves and form atoms. The atoms would conglomerate in huge volumes of gas speeding outward and gradually condensing into galaxies and stars as they sped along.

Naturally, only a small portion of the hydrogen-1 nuclei first formed would undergo collision with neutrons to form hydrogen-2; only a small portion of the hydrogen-2 nuclei would undergo a further neutron collision to form helium-3, and so on. Each successively more complex atom would be less common than the one before, and this would account for the fact that in the Universe today there is a more or less steady drop in the abundance of atoms with a rise in complexity.

The drop is not an absolutely uniform one. Helium-4 is much more common than either hydrogen-2 or helium-3 and iron-56 is much more common than most of the atoms less complex than itself. On the other hand, simple atoms such as those of lithium-6 or boron-11 are less common on a cosmic scale than they ought to be, considering their simplicity. But there is an explanation for this. Helium-4 and iron-56, for instance are both examples of particularly stable nuclei. They would react to form more complex atoms only with difficulty and would therefore pile up. The atoms of lithium and boron, on the other hand, react particularly easily and would "burn up".

Gamow's theory would account for the relative occurrence of the different atoms in the interstellar material. Once stars form, other changes take place in their cores.

Gamow's a theory has however, one serious flaw which he has not explained. The atoms must be formed one neutron at a time, and there is a gap that cannot be surpassed once the helium-4 is reached. The helium-4 nucleus is so stable that it has virtually no tendency to accept either a neutron or a proton. If a neutron does manage to attach itself to the helium-4 nucleus, it forms a helium-5 nucleus (two protons/three neutrons), which breaks down in about 0.000 000 000 000 000 000 001 seconds to form helium-4 and a single neutron again. On the other hand, if a proton manages to attach itself to helium-4, lithium–5 is formed and that breaks down to helium-4 again even more quickly.

Suppose, on the other hand, a helium-4 nucleus is struck by another helium-4 nucleus and the two fuse, although this is a much more unlikely occurrence than the neutron or proton fusion. Even so, it is useless as a way out, Beryllium-8 is formed and that breaks down to two alpha particles with super-rapidity too,

In other words, once you have formed helium-4 by neutron additions you are stuck. There is a gap at 5 and another at 8 that seem insurmountable.

It is possible of course, that two particles may strike the helium simultaneously. If a proton and neutron both strike and attach themselves then lithium-6 is formed and that will last about half a second before breaking up. That might be long enough to continue the process.

Unfortunately under the conditions postulated by Gamow in the first half-hour following the big bang, the individual nuclei are so widely dispersed that the chance of two particles striking the alpha particle simultaneously is virtually zero. The Gamow model, then, seems to account only for hydrogen and helium atoms but nothing beyond that.

It then was Fred Hoyle who suggested a theory that explained most of the previous problems. Hoyle considers that hydrogen-1 is the only original material and that everything else is formed within stars and is added to interstellar material by way of supernovae.

Hoyle makes use of the same mechanisms proposed by Gamow, but now there is the difference. In the stellar core, the density of matter is much higher than during the conditions Gamow postulates. The chance of a helium-4 nucleus being struck by two particles in an essentially simultaneous manner is therefore considerably better than in the Gamow theory. In fact, since the stellar core is richer in helium-4 than in anything else, there is a reasonably likely chance that a helium-4 nucleus will be struck by two other such nuclei in sufficiently rapid succession to form a carbon-12 atom. This would bypass the stable atoms between helium-4 and carbon-12 – the lithium, beryllium, and boron atoms previously mentioned. Those light atoms would be formed only by less common secondary processes, such as the break down of carbon–12, and that would account for their relative rareness in the Universe today.

There is also an interesting piece of evidence for this theory. The spectrum of certain unusual stars of spectral class S shows evidence for the presence of an element called "technetium". Technetium's a radioactive element that possesses no stable variety of atom. It follows that if technetium can be detected now, it cannot have existed at the time the star was formed (because of its instability) but must have made fresh will in the stars interior.

All in all Hoyle's theory seems to be the best.

THE SKY FOR DECEMBER 1972

| 1972 | | | DECEMBER E.S.T. | Min. of Algol | Sun's Selen. Colong. 0h U.T. |
|---|---|---|---|---|---|
| d | h | m | | h m | ° |
| Fri. 1 | 11 | | Uranus 6°N. of Moon | 9 10 | 211.77[b] |
| Sat. 2 | | | | | 223.96 |
| Sun. 3 | 01 | | Venus 7°N. of Moon | | 236.14 |
| | 01 | | Mars 5°N. of Moon | | |
| | 18 | | Venus 1.3° N. of Mars | | |
| Mon. 4 | 07 | | Mercury 7° N. of Moon | 6 00 | 248.33 |
| | 09 | | Moon at apogee (252,600 mi.) | | |
| Tues. 5 | 10 | | Mercury Stationary | | 260.52 |
| | 15 | 24 | New Moon | | |
| Wed. 6 | | | | | 272.71 |
| Thurs 7 | | | | 2 50 | 284.90 |
| Fri. 8 | | | Mercury greatest hel. Lat. N. | | 297.09 |
| | 01 | | Jupiter 0.3°N. of Moon | | |
| | 21 | | Saturn at opposition | | |
| Sat. 9 | | | | 17 20 | 309.09 |
| Sun. 10 | | | | | 321.46 |
| Mon. 11 | | | | 14 10 | 333.64 |
| Tues. 12 | | | | | 345.81 |
| Wed. 13 | 10 | 36 | First Quarter | | 357.98[l] |
| | 16 | | Geminid meteors | | |
| Thurs 14 | 01 | | Mercury greatest elong. W. (21°) | | 10.14 |
| Fri. 15 | | | | | 22.29 |
| Sat. 16 | | | | | 34.44[b] |
| Sun. 17 | | | | | 46.57 |
| Mon. 18 | 01 | | Mercury 0.2N. of Neptune | | 58.71 |
| Tues. 19 | 08 | | Moon at perigee (222,500 mi.) | | 70.83 |
| | 10 | | Saturn 4°S. of Moon | | |
| Wed. 20 | 01 | | Uranus 3°N. of Spica | 10 50 | 82.96 |
| | 04 | 45 | Full Moon | | |
| | 05 | | Mercury 6° N. of Aquarius | | |
| Thurs 21 | 13 | 13 | Solstice. Winter begins | | 95.08 |
| Fri. 22 | 09 | | Ursid Meteors | | 107.21 |
| Sat. 23 | 09 | | Venus 0.4°S. of Neptune | | 119.34 |
| Sun. 24 | | | | 7 40 | 131.47 |
| Mon. 25 | 09 | | Venus 6°N. of Antares | | 143.61[l] |
| Tues. 26 | | | | | 155.75 |
| Wed. 27 | 05 | 27 | Last Quarter | 4 30 | 167.90 |
| Thurs 28 | 19 | | Uranus 6°N. of Moon | | 180.06[b] |
| Fri. 29 | | | | | 192.22 |
| Sat. 30 | | | | 1 20 | 204.39 |
| Sun. 31 | | | Mercury at descending node | | 216.56 |
| | 17 | | Moon at apogee (253, 200 mi) | | |

[l]Dec. 13, -7.42°; Dec. 25, +7.32°
[b]Dec. 1, +6.73°; Dec. 16, -6.73°; Dec. 28 +6.83°