

H. A. D. News

*The Newsletter of the Historical
Astronomy Division of the American
Astronomical Society*

the rules for the Prize, the next biennial cycle will begin next winter with a renewed call for nominations.

First Doggett Prize Awarded Notre Dame, 1997

by Woody Sullivan, Chair,
HAD Doggett Prize Committee

We are delighted to announce that the first LeRoy E. Doggett Prize for Historical Astronomy has been awarded to Curtis A. Wilson, Professor Emeritus of St. John's College, Annapolis, Maryland. The brief form of the citation is as follows:

"Professor Wilson is cited for his decades of rigorous and exemplary work in the history of 18th- and 19th-century celestial mechanics, for his editorship and original contributions to Volumes 2A and 2B of the *General History of Astronomy*, and for the generations of students he taught and inspired through the reading and study of the works of Ptolemy, Copernicus, Kepler and Newton. Through it all, he has been a dedicated and selfless scholar, and serves as an example to us all."

Professor Wilson will receive his Prize at the January 1998 HAD/AAS meeting in Washington, DC, where he will give an address at the special symposium honoring LeRoy Doggett's life and scholarship. As specified in

by David DeVorkin, HAD Chair

Some 65 historians of astronomy, the largest gathering yet, descended on Notre Dame for the "Third Biennial History of Astronomy Workshop" from Thursday, June 19, through Sunday, June 22nd. Sponsored or endorsed by Notre Dame's Graduate Program in History and Philosophy of Science; Notre Dame's Reilly Center for Science, Technology, and Values; the History of Astronomy Special Interest Group of the History of Science Society; and the Historical Astronomy Division of the AAS, what we all started to call "ND3" was, once again, a terrific success. Thanks are due largely to Mike Crowe and his Notre Dame infrastructure. Mike and Steve Dick also conceptualized ND3, and once again did a great job.

From the Thursday evening reception at the Notre Dame Center for Continuing Education to the Business Meeting on Sunday, the business of the workshop was to talk, talk and talk some more. In addition to the formal theme sessions, the poster papers, the contributed paper sessions and the formal

social gatherings (by formal, I mean that they were planned more than a few minutes ahead), many of us fanned out across the campus and into the depths of South Bend, finding congenial places where we could deliberate over issues of mutual concern. Some of us discovered that great Thai food could unlock many historiographical mysteries, and others pondered our muse over the offerings at a quaint establishment that called itself "StudeBagels."

There were many highlights, surprises and intellectual delights awaiting us during the prepared formal sessions. I can only mention a few. Of course, I was very gratified that a thematic session on the uses of biography in the history of astronomy drew a great deal of useful commentary not only from the panelists but from the audience as well. Biography is alive and well, but only insofar as it remains sensitive to social, cultural and intellectual context. Among the survey papers, again there is space to give only a sampling. Bernard R. Goldstein's "Was there Anything Original in Ancient Greek Astronomy?" drew the most comment from the floor. The issue at hand was the question limits to rigorous interpretation of available text and the question of going beyond extant text. During the discussion, Noel Swerdlow engaged this issue, and an energetic debate followed, punctuated at times by comment from others, ranging from Dennis Rawlins to Peter Barker. Pamela Gossin dazzled us once again with her insight into the relationship between astronomical imagery and literature, calling attention to the importance of style in scholarly disputes and how they can reveal shared or discordant values. And Sara Schechner Genuth provided a fascinating glimpse into consumer culture as represented in the production and diffusion of sundials and other like timekeepers.

The Poster presentations provided great opportunities for participants and presenters to linger over specific issues, methods of historical inquiry, and the application of history in science education. We learned more about the history of the Notre Dame telescope from Robert Havlik, about the calendar and correspondence of Sir John Herschel (Mike Crowe), about how Frank Edmondson compiled his magnum opus memoir on the history of AURA, and about Tycho's Copernican campaign, a particularly well-crafted graphical presentation by Owen Gingerich and Robert Voelkel. Most engaging were the sets of videotapes Barbara Becker presented which were creative enactments of conversations and demonstrations of physical principles by historical figures. Not only fun to watch, they brought history alive and framed the now-traditional Saturday session on teaching history of astronomy and the sharing of syllabi, a session as strong and helpful as ever.

Later on Friday afternoon we were treated to a series of widely ranging contributed papers taking us back to Vedic astronomy, prehistoric earthworks in the mid-West, and an insightful re-examination of Augustine and Astrology, by Matthew Dowd, who was one of Mike Crowe's most energetic and helpful local hosts. Matt was there to meet and greet us, made sure everyone was settled in their new comfortable dorms, and then somehow found time to put on a jacket and tie (one of the few who did) and present us with the results of his recent work.

That evening, after scattering for dinner (some of us took a special liking to the local brew pubs), we met at Mike Crowe's home for more informal talking and to watch a video produced by Frank Edmondson on Indiana's astronomical pride, the American Kepler, Daniel Kirkwood. Some of us from previous Notre Dame gatherings again found ourselves in Mike's

“ND3”

basement --probably one of the largest personal libraries around and one that is always a delight to ponder. Our pockets were not checked at the door.

On Saturday, the session on teaching history of astronomy mentioned above (this time Owen Gingerich organized the session) brought in some familiar faces with refreshing issues and themes, including Dana Densmore, James Evans and Curtis Wilson to speak about how they incorporated history of astronomy into their different curricula. There was also a session on recent themes in Archaeoastronomy and a second contributed session. The archaeoastronomy was especially rich and refreshing. Steve McCluskey, Clive Ruggles, John Carlson, and Dave Dearborn all provided new and deeper insight into their specialty.

The second and third contributed sessions on Saturday afternoon and Sunday morning again demonstrated the broad landscape covered by historians of astronomy. Among many fascinating papers were Peter Barker's, who pinpointed what it meant to be a 'Copernican' before and after Kepler, and Nicholas Kollerstrom's, who described his numerical reconstruction of Newton's lunar theory and how he uses it to assess its accuracy. Rudi Paul Lindner's continued exploration of the institutional development of astronomy at Michigan, focussing on Michigan's southern station created by W. J. Hussey, provided a nice contrast to Brian Warner's description of John Herschel's Cape years almost a century earlier. Jordan Marchè's very insightful and welcome reassessment of the infamous "Committee of Ten," and its influence on astronomy education, demonstrated to my satisfaction that the committee was acting in concert with its times and was not the ogre some have claimed it to be. Jordan's paper

came close to the end of the Sunday session, but it was in very good company, including Matthew Frank's important study of how

astronomers were very slow to adopt Gibbs' vector method for the computation of orbits and Deborah Warner's successful linkage of VLBI and military and civilian global positioning systems in the context of trends in post-war astronomy in America.

The Morris Inn was once again the site for our banquet, this time capped by a fanciful personal exploration of the origin of the constellations by Alex Gurshtein. The Reverend Edward A. Malloy, President of the University of Notre Dame, provided a warm and thoughtful welcome, and Owen Gingerich introduced us to Alex and the history of their contact, first in the old Soviet Union (now the C. I. S.), and now on our shores. After the banquet, the campus of the college and calming skies made for some memorable walks, good conversation and, for die-hards, another attempt to scan the skies with the ancient, but refurbished, campus telescope. There was at least one rump session in the dorm that lasted well past midnight dealing with issues in the discipline and future prospects for Notre Dame meetings.

The last was the subject of the Business meeting, the results of which will play out over the next year as the architects for "ND4" deliberate over how to dovetail the meeting with the centennial of the AAS, set to begin on Memorial Day weekend in Chicago (and Yerkes somehow), 1999. This year many of us could not stay an extra week to attend the ASP meetings at Yerkes, which were very enticing because they marked the centennial of the observatory. But many did stay, and preliminary reports were that a terrific time was had by all.

AAS Centennial Planning

By Don Osterbrock,
Centennial Committee Chair

Plans are underway for the AAS Centennial, to be celebrated at the AAS Centennial meeting in Chicago, May 30 - June 3, 1999. The item requiring the longest lead time, the AAS Centennial Book, is well underway under the effective leadership of David DeVorkin, its editor. The aim is to produce a popular history of the Society which most AAS members will want to buy, read, and treasure. David drew up an outline for the book and, with the help of suggestions from Centennial Committee members, selected authors for the 28 chapters. After vigorously hounding them, he has received 24 of their manuscripts on a timely basis, edited all of those and sent them to the publisher. Of these 15 have been through the full cycle of copy-editing, returned to the author and to David for checking, and are now back at the publisher ready to go. Our one worry is that the AIP Press, with whom the AAS signed a contract for publication, has gone through several traumatic transformations since then, and almost all the people we started with are no longer there! David and Bob Milkey are keeping a close eye on the situation, and we hope that the book will come out a triumph of publishing at an affordable price, on schedule!

Sara Schechner Genuth, our Centennial Curator, with the help of some Centennial Committee members is assembling the AAS Centennial Display. It will consist of photographs and photocopies of documents significant in the history of the Society. This Display will first be exhibited at the Centennial meeting, and afterward will travel to AAS and AIP headquarters, and to universities, observatories and research centers which wish to display it (and can afford the shipping and

security costs associated with it).

The Centennial Committee has already decided to recommend to the AAS Council three sessions or events for the Centennial meeting, to be organized by the Society itself. One is an invited talk, before the whole Society, in an unparalleled session, on the history of the AAS. We will recommend that our best expert on the history of the AAS give this talk. The second is an unparalleled session, before the whole Society, on the future of the AAS, with three (or possibly four) invited speakers. We will recommend that they be the authors of the articles on this subject which David has commissioned for the Centennial Book. All of them will be Past Presidents of the Society. The third event is a half-day session, in parallel with other (mainly scientific) sessions, on "My most memorable AAS meeting." The speakers will be AAS members who are not historians, spanning a wide range of ages, types of institution, *etc.* We will recommend that on that same day the AAS hold a poster session on that same subject, with every paper submitted for it to be accepted either as a poster paper or as one of the necessarily few papers for which there will be time for oral presentations.

In addition, we will very probably recommend that the AAS arrange, in conjunction with the Yerkes Observatory and University of Chicago members of the Centennial Committee, a one-day field trip to the Observatory, where the AAS came into existence back in 1899. If possible, this visit should extend into the evening, for viewing with the 40-inch refractor, providing the weather cooperates.

The Centennial Committee at the moment is considering one or two other events which may be added to this list. In addition we will recommend that the AAS prepare a few types of Centennial souvenirs, probably including T shirts, mugs, and possibly briefcases, ties and

scarfs, to be on sale at the meeting and throughout the Centennial year.

In addition, the Centennial Committee has encouraged the HAD officers and Committee to plan a two-day meeting with the AAS in Chicago, with sessions for contributed and invited historical papers, some related to the Centennial, and some on any other subject in the history of astronomy. Such sessions, of course, will be organized by the HAD.

I would welcome comments or suggestions from any member of the HAD or of the AAS. Please send them directly to me, and also discuss them with or send them to any member(s) of the Centennial Committee you wish.

Thank you very much.

From the Chair

The LeRoy E. Doggett Prize for Historical Astronomy was established in 1996 with a \$10,000 donation in his name to recognize good works and workers in the history of astronomy. Its goal is to act as a stimulus to the field generally, in the manner in which LeRoy Doggett did in his own life.

Contributions can be in any amount, but will be recognized in distinct categories. Additional donations received by the AAS Office as of July 15, 1997 are listed below. Those made in honor of a person or an organization are noted in parentheses.

1000: Marjorie and Roderick Webster.

250: Thomas R. Williams.

200: Ruth S. Freitag; Joseph S. Tenn; Gerald Hawkins (Julia M. Dobson and Simon

Newcomb); Colleagues of Jane Ozenberger

150: David DeVorkin; Anna Sofaer (Solstice Project).

100: Diana Alexander; Frank Bash; Frank and Margaret Edmondson (Victor E. Thoren); R. H. Garstang; Dorrit Hoffleit; Jo and Irving W. Lindenblad (Jane Ozenberger); Stephen P. Maran; Curtis Wilson; Elizabeth Barker.

50: Steven J. Dick; Andrew Fraknoi (George Abell); Alan D. Fiala; Alan Harris; Elizabeth Roemer; Donald K. Yeomans; Michael Mendillo; Marie R. Lukac; Bruce Stephenson (Adler Planetarium); Ron Doel.

25: Sara Schechner Genuth; Woodruff Sullivan; Stephen G. Brush; E. C. Krupp; Roy E. Laubscher; Rolf Sinclair; Anonymous.

Our deepest thanks to one and all who contributed, either with funds or with letters of appreciation. As we near the level of \$15,000 in our endowment, we invite all members of the HAD to continue to contribute to this, our Prize fund.

David DeVorkin

Report from the Archeoastronomy Committee

I am ready to hear from those who are interested in the Archeoastronomy Committee. I now have some time to get this going. I may be contacted by e-mail.

David G. Iadevaia, Chair
A P I Airbourne Precision Imaging
2968 W. Ina Rd., Ste 275
Tucson, AZ 85741
520-544-7896 www.rtd.com/~api

Report from the Obituary Committee

During the first half of 1997, the AAS office and/or the Obituary Committee received notice of the deaths of 35 members, former members, and prize winners. This includes a few carry-overs from previous years and is to be compared with 22 obituary notices published in the 1996 BAAS. So far, 24 write-ups have been forwarded to the AAS office, three more are in hand awaiting minor editing and transmission, and six have been promised by suitable writers. At this moment, authors are needed for three notices: Beat Wackernagel, Allan S. Jacobson, and Jenő Barnothy. None of them is expected to present major problems, but volunteers are always very welcome, especially to write about colleagues whose death you may hear about in the future. The Committee currently includes Laurence Fredrick (U. Virginia) and David DeVorkin (Smithsonian), and another volunteer or two would be welcome.

Virginia Trimble, Chair

From the Secretary

This issue inaugurates what I hope will be a series of Book Reviews of interest to the HAD. Rather than scholarly reviews, the idea is to provide practical information to our membership. This Dorrit Hoffleit has done, and moreover she has brought to the review the delightful statistical approach, by which she has served astronomy throughout her professional career. (Readers will be reminded of David DeVorkin's article, about the Yale Conference in honor of Dr. Hoffleit, that appeared in the May *HAD News*.) Volunteers

eagerly are sought for future *News Book Reviews*.

Elsewhere in issue #41, David DeVorkin is once again our correspondent, this time on the Third Biennial History of Astronomy Workshop held at Notre Dame University. Editing this article was painful--only because it demonstrated how much I had missed by not attending! Look for information on the Fourth Workshop, in *HAD News* sometime next year.

Thank you for all your comments on the look and content of *HAD News*. My personal "gripe" about issue #40 was the blank sheet attached (by my university Print Services) as a "back cover." It is my goal to save that particular tree in future issues . . .

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Fax: (319) 273-7124
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Book Review

by Dorrit Hoffleit (Yale University)

History of Astronomy, an Encyclopedia, John Lankford, Ed. Garland Pub. Inc., ISBN 0-8153-03322-X. 594 pp., \$95.

This volume should be a welcome addition to any astronomer's shelves. Its stated purpose is to "furnish concise historical information and summarize the latest research in a form accessible to those without scientific or mathematical training." Nevertheless the scope of subject matter indicates its usefulness as a reference source for professional astronomers as well. It contains over 300 articles by 75 contributing authors, including 16 from ten foreign

countries. It is remarkable how consistent the style has been maintained among so many authors. (The volume is dedicated to the memory of LeRoy E. Doggett (1941-96) who wrote 15 of the articles, more than any other contributor.)

The individual articles range from a single paragraph under a third of a column, to 26 columns for *Astrometry*. *Cosmology* occupies some 31 columns, but is divided into four sections, each by a different author. They are arranged alphabetically as *Ancient Greek*, *Contemporary*, *Medieval*, and *Modern*. Chronologically *Contemporary* would follow *Modern*. There is some overlap between the two, *Modern* taking us to 1965, *Contemporary* from 1940 to 1993.

The *Preface* states, "In an ideal world, this encyclopedia would have been much longer. Limitations of space and the availability of contributors were serious constraints," adding, "Perhaps these lacunae will stimulate fresh research initiatives." Before sampling the subjects actually covered, and in order to estimate the incompleteness, I made a random list of about 100 names and 100 topics (a few under each letter of the alphabet) that I might like to look up in a reference source such as this. I then checked the index, which cited 51% of the names and 62% of topics I had listed. I then selected 10 out of each group to see if they were mentioned in other articles with presumably relevant titles. Among the names omitted are, for example, Al Sufi, Bok, Doppler, Fabricius, Leavitt, Lutyen, W. W. Morgan, Öpik, Unsöld, and Zinner. Although not cited in the index, Bok is mentioned in the article *Australia and New Zealand*. The Doppler shift is noted under *Radial Velocity*, but there is nothing about Doppler's life. Fabricius, discoverer of Mira, and Leavitt, discoverer of the important period-luminosity relation for Cepheid variables, are mentioned

in *Variable Star Astronomy*. The Morgan-Keenan MK system is briefly mentioned on page 489, *Spectroscopy, Astronomical*; Öpik under *Meteors*; and Ernst Zinner's history of astronomy is given as a reference under *Germany, Astronomy since 1600*.

Among subjects not cited in the index are Algol, brown dwarfs, evolution (stellar), flare stars, globules, interstellar matter, Julian day, MACHOS, quantum theory, and zero age. Of these I found Algol under *Variable Star Astronomy*, where the history of theories of evolution of variable stars also is discussed. The index includes the term "mechanism of star formation" and cites the section on *Double Star Astronomy* which briefly mentions historic theories on double star formation. The article on the *Hertzsprung-Russell Diagram* of course mentions the relevance of the diagram to Russell's early theory, as well as subsequent theories of stellar evolution. While there is an article on the Julian Calendar, this is not the same as the Julian day, a serial number for successive days so essential for variable star studies. Quantum theory can be found mentioned in *Spectroscopy, Astronomical*, in the section "The Birth of Quantitative Astrophysics."

In his *Preface* Lankford defines his use of *Units of Measurement*. With two exceptions they are standard abbreviations. But for B. C. he has adopted B. C. E. meaning Before the Common Era, and for A. D. he uses C. E. meaning the Common Era. This convention presumably originated in Israel, but I have not been able to find a reference to its recommendation for universal adoption.

On page 439, A. Gurshtein (*Russian Astronomy*) credits F. G. W. Struve as the first to have determined a stellar parallax. But on page 950 S. J. Dick states that Bessel was one of the first; and similarly on page 499 V. A.

Bronshthen credits Struve with being one of the first. Actually three parallaxes were determined almost simultaneously, but not published in precise chronological order. The third was by Thomas Henderson, for alpha Centauri, actually determined first but published last because he waited for further observations to confirm his conclusion.

The apparent deficiencies mentioned above by no means cast aspersion on the value of this compact encyclopedia. They are meant to encourage the Editor to consider a supplementary volume or second enlarged edition. No biographical dictionary or encyclopedia can ever contain everything everyone wants. This edition has very much in its favor: profuse references and good materials for browsing, as well as for specific information . . . So good we'd like more!

[Dr. Hoffleit wrote five articles for the Encyclopedia - Ed.]

From the Lucubratory

Woody Sullivan (University of Washington)*

Here's an acrostic [page 10] for your enjoyment. Half of the clues relate to the person who made the quotation to be found in the numbered grid; his name is spelled out by the first letters of each word. Directions: Answer each clue and then write the letters in the grid by matching numbers under each letter with the corresponding numbered boxes. If you want to work backwards, the small letter in each box indicates the clue to which it belongs. Good luck! [The answers to Dr. Sullivan's puzzle appear on page 9. - Ed.]

Last time the trivia question was to name the poet who wrote:

For age is opportunity no less
Than youth itself, though in another dress,
And as the evening twilight fades away
The sky is filled with stars, invisible by day.

Joe Tenn is our winner, although he found it by a search on the Web. Indeed it is an excerpt from Henry Wadsworth Longfellow's *Morituri Salutamus*. This time we ask something apropos to the topic of the acrostic: Which famous inventor donated funds to which physicist for a "differential refractometer" experiment carried out in Berlin in 1881?

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Upcoming Meetings

Here is a list of meetings, of potential interest to members, not previously listed in the *HAD News*. (Some notices have been extracted from the Electronic Newsletter for the History of Astronomy*, edited by Wolfgang Dick and translated by Donald Bellunduno.)

9-12 September, Mykolayiv, Ukraine

The Role of Ground-Based Astrometry in the Post-HIPPARCOS Period (program topics include the history of the Mykolayiv [Nikolaev] Astronomical Observatory)

Contact: Organizing Committee, Ukraine,
327030, Mykolayiv, Observatorna 1,
Mykolayiv Astronomical Observatory
Fax: (380512) 35 25 56
e-mail: mao175@mao.nikolaev.ua

12-15 September, Mount Wilson, California

Sixth Annual Convention of the Antique Telescope Society

Contact: Bart Fried
e-mail: nuvista@compuserve.com

14 September, Cittadella (PD), Italy
 Unione Astrofili Italiani, XXIX Congresso
 Nazionale, Sessione "Storia e Cultura
 Astronomica"
 Contact: Francesco Azzarita, Via Fanelli 206
 M, 70125 Bari, Italy

26-28 September, Lutherstadt Wittenberg,
 Germany
 Astronomy, Astrology, und History
 Contact: Evangelische Akademie Sachsen-
 Anhalt, Schlosstr. 15, D-06885
 Lutherstadt Wittenberg, Germany

3-5 October, Porto San Giorgio (Ascoli
 Piceno), Italy
 Annual Meeting of the Italian Gnomonists
 Contact: Francesco Azzarita
 e-mail: azzarita@teseo.it

10-14 November, Padova, Italy
 Guiseppe Toaldo and his Time (1719-1797)
 Contact: Luisa Pigatto, CONEGNO TOALDO,
 c/o Osservatorio Astronomico, Vicolo
 dell'Osservatorio, 5, 35122 Padova, Italy
 Tel.: (49) 8293469
 Fax.: (49) 8759840
 e-mail: Toaldo@astrpd.pd.astro.it

*http://www.astro.uni-bonn.de/~pbrosche/hist_astr/ha_meet_1997.html

Recent Discussion "Threads"

on the History of Astronomy Discussion Group
 (HASTRO-L)

- The Eccentricity of the Earth's Orbit
- Imperial Roman Maps
- Early American Planetaria
- Plutarch
- Cassegrain
- Planetary Tables
- Attempts to Blow Up the RGO
- Airborne Astronomy
- The Dearborn Observatory

- The Closure of the RGO
- Flamsteed Numbers
- Stellar Magnitude Estimation
- Rudolph Thiel
- Baker's 40-60 Epicycles
- A HASTRO-L Archive
- The LeRoy Doggett Memorial Book Fund and AAS Doggett Prize
- The Date of the Farnese Globe
- John Hartnup
- The Arbor Low Stone Circle

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SUB HASTRO-L [your name]

to:

listserv@wvnm.wvnet.edu

New Web Pages of Interest

[These address were checked, and found to be valid, on 27 July, 1997.]

The X-33 History Project Website

<http://www.hq.nasa.gov/office/pao/History/x-33/home.html>

Ancient India's Contribution to Astronomy

<http://members.tripod.com/~sudbee/astro.html>

Riccioli Excerpt Facsimile (about Mizar)

<http://www.sci.muni.cz/~ondra/mizar/mizar.html>

H. Infects	A. aura
J. Niels	B. lousy
K. Speedoflight	C. Bowie
L. Theaether	D. etui
M. ErnstMach	E. routes
N. Inertia	F. tux
P. Nicest	G. E mce

ACROSTIC

- A. $\frac{\quad}{10} \frac{\quad}{15} \frac{\quad}{47} \frac{\quad}{25}$ a surrounding glow; Latin for "breath, breeze"
- B. $\frac{\quad}{16} \frac{\quad}{49} \frac{\quad}{11} \frac{\quad}{6} \frac{\quad}{43}$ infested with lice
- C. $\frac{\quad}{8} \frac{\quad}{5} \frac{\quad}{22} \frac{\quad}{13} \frac{\quad}{3}$ Jim, the knife guy at the Alamo in 1836
- D. $\frac{\quad}{9} \frac{\quad}{1} \frac{\quad}{50} \frac{\quad}{19}$ a small ornamental case for needles, etc.
- E. $\frac{\quad}{31} \frac{\quad}{60} \frac{\quad}{61} \frac{\quad}{7} \frac{\quad}{23} \frac{\quad}{38}$ pathways
- F. $\frac{\quad}{12} \frac{\quad}{72} \frac{\quad}{28}$ a formal suit
- G. $\frac{\quad}{27} \frac{\quad}{4} \frac{\quad}{24} \frac{\quad}{35}$ equality of energy and mass
- H. $\frac{\quad}{37} \frac{\quad}{20} \frac{\quad}{14} \frac{\quad}{30} \frac{\quad}{81} \frac{\quad}{17} \frac{\quad}{44}$ affects with disease
- J. $\frac{\quad}{26} \frac{\quad}{32} \frac{\quad}{33} \frac{\quad}{68} \frac{\quad}{51}$ a great Dane of science (first name)

- K. $\frac{\quad}{55} \frac{\quad}{29} \frac{\quad}{36} \frac{\quad}{41} \frac{\quad}{79} \frac{\quad}{65} \frac{\quad}{66} \frac{\quad}{69} \frac{\quad}{48} \frac{\quad}{21} \frac{\quad}{2} \frac{\quad}{39}$ 1.80×10^{12} furlongs per fortnight (3 words)
- L. $\frac{\quad}{45} \frac{\quad}{18} \frac{\quad}{46} \frac{\quad}{67} \frac{\quad}{58} \frac{\quad}{53} \frac{\quad}{40} \frac{\quad}{64} \frac{\quad}{62}$ the fifth essence; the medium for propagation of light (2 words)
- M. $\frac{\quad}{73} \frac{\quad}{71} \frac{\quad}{34} \frac{\quad}{59} \frac{\quad}{70} \frac{\quad}{42} \frac{\quad}{74} \frac{\quad}{63} \frac{\quad}{57}$ physicist & philosopher active one century ago (2 words)
- N. $\frac{\quad}{52} \frac{\quad}{78} \frac{\quad}{86} \frac{\quad}{75} \frac{\quad}{56} \frac{\quad}{54} \frac{\quad}{77}$ a property of a body proportional to its mass
- P. $\frac{\quad}{84} \frac{\quad}{82} \frac{\quad}{85} \frac{\quad}{83} \frac{\quad}{80} \frac{\quad}{76}$ most pleasant

PUZZLE FORM

1 D	2 K	3 C		4 G	5 C	6 B	7 E		8 C
9 D	10 A	11 B	12 F	13 C	14 H	15 A	16 B		17 H
18 L	19 D	20 H	21 K		22 C	23 E		24 G	25 A
26 J		27 G	28 F	29 K	30 H	31 E	32 J	33 J	34 M
35 G	36 K		37 H	38 E		39 K	40 L	41 K	
42 M	43 B	44 H	45 L	46 L	47 A	48 K	49 B	50 D	51 J
	52 N	53 L		54 N	55 K		56 N	57 M	58 L
	59 M	60 E	61 E	62 L	63 M	64 L		65 K	66 K
	67 L	68 J	69 K		70 M	71 M	72 F	73 M	
74 M	75 N	76 P		77 N	78 N	79 K		80 P	81 H
82 P	83 P	84 P	85 P	86 N					

PUZZLE FORM (SPARE COPY)

1 D	2 K	3 C		4 G	5 C	6 B	7 E		8 C
9 D	10 A	11 B	12 F	13 C	14 H	15 A	16 B		17 H
18 L	19 D	20 H	21 K		22 C	23 E		24 G	25 A
26 J		27 G	28 F	29 K	30 H	31 E	32 J	33 J	34 M
35 G	36 K		37 H	38 E		39 K	40 L	41 K	
42 M	43 B	44 H	45 L	46 L	47 A	48 K	49 B	50 D	51 J
	52 N	53 L		54 N	55 K		56 N	57 M	58 L
	59 M	60 E	61 E	62 L	63 M	64 L		65 K	66 K
	67 L	68 J	69 K		70 M	71 M	72 F	73 M	
74 M	75 N	76 P		77 N	78 N	79 K		80 P	81 H
82 P	83 P	84 P	85 P	86 N					