



# Water Scarcity and Energy Production in New Mexico

Vol 99 No. 3 Autumn/Winter 2013

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## ANNOUNCEMENTS

- **November 9, 2013.** Our annual meeting this year will be on "Impacts of Climate Change on Water" and "Sustainable Energy Development" in New Mexico, co-hosted with NM EPSCoR. Plan to join us for the symposium, awards ceremony, distinguished lecture, and banquet. The event will take place in the Marriott Pyramid hotel in Albuquerque. Register now!
- Awards for NM's *Outstanding Science Teachers* will be given out at the Annual Meeting. Come support our state's great educators!
- This year's ballot for elections and bylaws amendments can be found on the back page of this newsletter. You can fill it in and mail the whole page along with your 2014 membership form or donation to NMAAS by November 9, 2013 (you must be paid up for you ballot to be counted). Info on the officer candidates is on pages 5-6, and more details about the bylaws amendments can be found in a document on our website <http://nmas.org/>.

NMAS & NM EPSCoR ANNUAL MEETING &  
SYMPOSIUM

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9 NOVEMBER 2013 ABO MARIOTT PYRAMID

To register online please visit: <http://www.nmepscor.org/events>

**New Mexico Academy of Science Board Members**

President  
 Dr. Kurt Anderson  
 Professor of Astronomy, NMSU (Emeritus)  
 kurt@nmsu.edu

President Elect  
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Vice President  
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 Asst. Professor of Astronomy, NMSU  
 jasonj@nmsu.edu

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Secretary  
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Director, NMAS Education Awards  
 Mr. Harry Pomeroy  
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Director, Community Relations  
 Vacant

Director, New Mexico - National Youth Science  
 Camp  
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 Mr. Hal Behl  
 Aerospace Engineer (retired)  
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Director-at-Large  
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 History & Science  
 deb.novak@state.nm.us

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 Professor, NMSU (Emeritus)  
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Director Emeritus  
 Mrs. Mona Pomeroy  
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Director Emeritus  
 Dr. Maureen Romine  
 New Mexico Highlands University  
 Biology and Chemistry Dept.  
 romine.m@nmhu.edu

Editor, New Mexico Journal of Science  
 Dr. Kurt Anderson

NMAS Webmaster  
 Vacant

**NMAS MEMBER NEWS**

NMAS welcomes new and returning members, officers, and board members.

**Our thanks to those who have made donations to the NMAS this year**

**General Fund 2013**

Harry and Mona Pomeroy  
 Anonymous (through United Way)

**Endowment 2013**

Richard Nygren (through United Way)  
 David Duggan (through United Way)  
 Hal Behl  
 Robert L. S. Amari  
 Mercedes M. Agogino  
 Relf Price  
 Vicente Romero (new Life Membership)  
 Mel and Pauline Eisenstadt

*Why not plan ahead today to make the NMAS a part of your legacy!*

FROM THE NMAS TIME CAPSULE . . .

**NMAS Past Presidents (1902-1936)**

Partial list, to be continued . . .

- 1936 E.R. Harrington
- 1935 John D. Clark
- 1934 H.C. Gossard
- 1933 Sterling B. Talmage
- 1932 E.W. Lighton
- 1931 E.H. Wells
- 1930 A.O. Bowden
- 1929 F.M. Denton
- 1928 R.W. Goddard
- 1927 K.M. Chapman
- 1926 T.G. Rodgers
- 1925 D.S. Robbins
- 1924 David Spence Hill
- 1923 E.H. Wells
- 1921 John D. Clark
- 1920 L.A. Highley
- 1919 John D. Clark
- 1917 Paul A.F. Walters
- 1916 C.T. Kirk
- 1915 E.P. Humbert
- 1902 Frank Springer

NMAS Newsletter  
 Volume 99 No. 3  
 Autumn/Winter 2013

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**New Mexico Academy of Science**

Founded in 1902 to foster scientific research and scientific cooperation, increase public awareness of the role of science in human progress and human welfare, and promote science education in New Mexico. NMAS has been in continuous existence since 1915, and became formally associated with the New Mexico Museum of Natural History and Science in 1995.

*Affiliated with the American Association for the Advancement of Science (AAAS)*

*Member of the National Association of the Academies of Science (NAAS)*

## PRESIDENT'S MESSAGE - OCTOBER 2013

Kurt Anderson

### **Water Scarcity and Energy Production in New Mexico**

New Mexico is a leading US producer of coal, crude oil, and natural gas and its borders contain significant reserves of these resources. At present rates of extraction its oil and gas reserves should last well into the 21st century, largely because of enhanced extraction techniques such as hydraulic fracturing. Some geothermal resources are under development. Finally New Mexico has the largest (and largely unexploited) deposits of uranium in the United States. New Mexico's water resources, however, are very limited and are expected to grow more so in the near future. Unfortunately, mining and drilling for fossil fuels and their use for electrical energy production all require considerable amounts of water. Fossil fuel producers in New Mexico - and the electrical power plants that use those fuels - will face increasing competition with other users as water becomes an increasingly scarce commodity.

New Mexico is a net exporter of electric power, almost all of which is generated in coal- or gas-fired power plants. These require large amounts of water for their operations. Mining, coal mining in particular, seems always to result in the production of highly polluted water that can contaminate both surface and groundwater. Coal is often transported using large volumes of water to the furnaces of power plants where the still-liquid mixture is burned. This water is lost to the atmosphere in smoke. Additional water is released as steam and vapor from turbines and cooling towers. Gas and oil fields yield significant amounts of "produced water," which finds its way into holding ponds intended to prevent its contamination of the environment. Even more water is required for hydraulic fracturing where water mixed with sand and chemicals is injected into deep wells to extract oil and gas. The chemical-laced produced water that emerges from the well must be disposed of in some environmentally sound way but that which remains underground can pose threats to natural groundwater. Large amounts of water can also be required to develop a geothermal resource.

Biofuel production also requires large quantities of water. Basically, water and atmospheric carbon dioxide (a greenhouse gas) are converted into plant material via photosynthesis and that material is converted into a burnable fuel (e.g., wood, corn ethanol, biodiesel). This is almost carbon-neutral since efficient burning of the fuel releases almost all of the carbon. While biofuel production does consume a large amount of water, that water may be unsuitable for other purposes because of its salinity or other contaminants. Electrical energy production using "non-renewable" resources (e.g., fossil) requires large amounts of water in the production of the fuel and its conversion to electric power. Indeed, an increasing shortage of usable water, rather than the exhaustion of our fossil fuel reserves, may ultimately limit our production of those fuels and the electric power they provide. Fortunately, while New Mexico may grow increasingly water-poor, it has an abundance of "renewable" energy in the form of sunlight and wind. A wind or solar power plant requires little water for its operation - and its "carbon footprint" is also vanishingly small.

## NMAS and NM EPSCoR Annual Meeting and Symposium

**What:** Joint Annual Meeting of NMAS and NM EPSCoR. Agenda includes a luncheon, keynote talk (see below), oral and poster presentations, reception, and NMAS Awards Ceremony.

**Where:** The Marriott Pyramid. 5151 San Francisco Road NE, Albuquerque, NM 87109.

**When:** Saturday, November 9 2013, 11:00-18:30 MST.

**How much:** Only \$25.00 (free for NM EPSCoR participants).

**Who is invited:** Everyone! NMAS members, students, educators, concerned citizens, and community members.

**How to register:** Register online at: <http://www.nmepscor.org/events>. Then mail in your payment to NMAS.

**Who to contact:** Mary Jo Daniel, Associate Director of NM EPSCoR ([mjdaniel@epscor.unm.edu](mailto:mjdaniel@epscor.unm.edu)). Michaela Buenemann, NMSU and NMAS President Elect ([elabuen@nmsu.edu](mailto:elabuen@nmsu.edu)).

More details here: <http://www.nmepscor.org/events>

Keynote Speaker  
Prof. Fred Phillips  
New Mexico Tech.

### New Mexico's Dwindling Water Supply: Can We Solve a 21st Century Problem using 19th Century Laws?

**Abstract:** Predicting changes in precipitation in the Southwestern U.S. under continuously warming climate is an uncertain proposition, but predicting change in the water balance is not. As climate warms, the water balance becomes less favorable

and the renewable water supply decreases. New Mexico has fully allocated its water resources under the present climate, but as the 21st century progresses, the water supply will dwindle while the population increases. Something has to give. The laws governing water management in New Mexico were placed in the State Constitution in 1907. The principle of those laws is that water in its natural state belongs to the people of the state, but they reflect the zeitgeist of that period, which was to encourage rapid expansion of irrigated agriculture and to make sure that the rights to water withdrawal thus established would be firmly protected. As the intervening 106 years have passed, the public's perception of what they want to accomplish with New Mexico's limited supply of water has changed, but the fundamental laws have not. There is no longer any unappropriated renewable water, and thus putting water to any new use, such as growth in urban population, necessarily involves taking it away from existing users, or from the environment. Equitable reapportionment that is responsive to the interests of the 21st century public requires a system of water management that is flexible and responsive to a changing environment, but the state is operating within the straightjacket of a 19th century water code whose principal objective is to prevent change. Australia and South Africa offer examples of nations who have radically changed their water codes. New Mexico should look to them for inspiration in solving its ongoing water crisis.

*Dr. Fred Phillips is a Professor of Hydrology and Director of the Hydrology Program in the Department of Earth & Environmental Science at New Mexico Tech in Socorro. His undergraduate degree in Earth Science is from the University of California at Santa Cruz and he earned a PhD in hydrology from the University of Arizona in 1981. His current research interests include environmental tracers in surface water and groundwater, paleoclimate and paleohydrology, surface-exposure dating using cosmogenic nuclides, tectonic geomorphology, and the interactions of social and hydrological systems in the southwestern U.S.*

Please come to the annual meeting to hear this very timely and exciting talk. More info about Dr. Phillips can be found at <http://www.ees.nmt.edu/phillips/>

## Biographies of Board Nominees on This Year's Ballot

*This year we have 2 candidates for Vice President, 2 candidates for the open Director-at-Large position, and 1 candidate for Treasurer. Please consider each candidate and vote for your choice on the ballot on the last page of this newsletter and mail back to NMAS. Note: You must be a 2013 paid-up member to vote. Send your ballot and membership form at the same time for full voting privileges!*

### Shanalyn Kemme (candidate for Vice President)

Dr. Kemme is a Distinguished Member of the Technical Staff at Sandia National Laboratories. She has over 28 years of experience working in classical and physical optics, including: diffractive optical elements (DOE), holographical OE, computer-generated holograms (CGH), micro-optical and fiber-optical design, fabrication, and integration. She coordinates a team of Sandians with expertise in all facets of OE realization, including theoretical modeling, numerical simulation, microsystems fabrication, characterization, and microsystem assembly. Recent projects include LIDAR and thermal management using diffractive and plasmonic components, and development of a free-space optical transponder led to a prestigious R&D 100 Award in 2002.

Dr. Kemme holds 4 patents, has presented over 15 invited talks, and has authored over 60 conference and peer-reviewed papers. She received her PhD in Optical Sciences at the Optical Sciences Center, University of Arizona, in 1998, and was named Adjunct Professor this year. Dr. Kemme is heavily involved in SPIE - The International Society for Optical Engineering - as a member and Program Committee member. She serves on two regional advisory boards: OP-TEC, a National Center for Optics and Photonics Education, as well as the CNM Photonics Technology Advisory Board.

She is a strong advocate for the sciences; particularly in applying fundamental scientific principles to predict and realize real-world results. She feels that the field of science is negatively impacted by several stereotypes that diminish public interest and participation - it is too difficult, it is for nerds, it is for boys, it is not relevant to daily life.

It is Dr. Kemme's hope that her participation as a NMAS officer will help encourage participation in the sciences and allow her to help erase some of these negative stereotypes.

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### Hartono (Anton) Sumali (candidate for Vice President)

Dr. Sumali has been the manager of the Science, Technology and Engineering (ST&E) Integration Department at Sandia National Laboratories in Albuquerque since 2011. His department performs studies and analyses of ST&E programs throughout Sandia to support programmatic decision making by executives at Sandia and the U.S. Department of Energy. From 2002 to 2011, he was a Principal Member of the Technical Staff in Sandia's Engineering Sciences Center, where he performed research on Micro- and Nano-mechanics, Structural Dynamics, Acoustics, Micro Electro-mechanical Systems, Adaptive Optics, and Micro-Biomechanics. Upon receiving his Ph.D in Mechanical Engineering from Virginia Tech in 1997, Dr. Sumali became an Assistant Professor at Purdue University in Indiana. He has done research work for the US Naval Research Laboratory, Caterpillar Inc. in the US and Japan, McDermott Inc. in Singapore, and the Federal University of Viosa in Brazil. He has published over 100 papers in scientific journals and proceedings. He is an editor of several journals and holds a patent in energy harvesting.

Awards and honors that Dr. Sumali has received include the Potter Award (highest teaching award from Purdue University's College of Engineering), the Teetor Award from SAE International (Society for Automotive Engineering), the Best Journal Paper Award from the journal *Engineering and Technology for a Sustainable World*, and several others. Dr. Sumali is an active organizer in professional societies including the American Society of Mechanical Engineering (ASME) and the Society for Experimental Mechanics (SEM). He has given invited presentations at various institutions worldwide, such as the Plenary Speech at Mexico's National Conference of Electronics Engineering. He speaks fluent Spanish, and has taught engineering courses in Portuguese.

Dr. Sumali is interested in advancing science in New Mexico, particularly by serving as the Vice

President of the New Mexico Academy of Science. He would like to contribute to, and facilitate the adoption of, the Next Generation Science Standards that emphasize engineering design, and have the opportunity to help with the annual teacher award process and the paper competition in conjunction with New Mexico science fairs.

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### Hal Behl

*(candidate for Director-at-Large)*

Hal is just finishing his first 2-year term as Director at Large. He is a long-term NMAS member and contributor. In addition, he is a long-term trustee of the National Museum of Nuclear Science and History (now Trustee Emeritus); a trustee of the Albuquerque Museum of Art and History; an ex-treasurer, VP, and President of the Maxwell Museum Association; and a Board member of the Cavalcade of Wings and Adventures in Anthropology.

Hal is retired, with 45 exciting years experience in rocket, missile, launch vehicle, and satellite fields with Douglas, Boeing, RCA, R&D Associates; and consulting with the Naval Research Lab and the Strategic Defense Initiative Office. During WWII, he was an Engineering Supervisor in the Manhattan District's (Atomic Bomb program) K-25 laboratory in Oak Ridge where he was awarded patents on high-vacuum components and mass spectrometer tubes. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Fellow of the Institute for the Advancement of Engineering. He is widowed, has three married sons, four grandchildren, four GREAT grandchildren, and has spent almost 40 years in New Mexico.

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### Jim Murphy

*(candidate for Director-At-Large)*

Dr. Murphy is an Associate Professor of Astronomy at NMSU. He obtained his BS at Texas A&M in 1984, and PhD at U. of Washington in 1991. His research interests center on what can be called Martian Meteorology. He's involved in a wide array of research efforts focused upon the weather and climate of the planet Mars. These involve analyses of data returned by orbiting and landed spacecraft and

use of computer models to simulate various aspects of the atmosphere (global and local-scale weathers, near-surface environmental characterization for landed spacecraft, etc.).

He's been directly involved with spacecraft missions as a competitively selected scientist (Mars Pathfinder, Mars Microprobe/Deep Space 2, Mars Polar Lander), as a member of an Aerobraking Advisory Group (AAG) (Mars Global Surveyor, Mars Climate Orbiter, Mars Odyssey, Mars Reconnaissance Orbiter). In addition, Dr. Murphy has provided environmental characterization information for the Mars Exploration Rovers and subsequent landers.

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### Vincent Gutschick

*(candidate for Treasurer)*

Dr. Gutschick got a BS in Chemistry from Notre Dame in 1966 and a PhD from Caltech in 1971. After a successful career in Biology in academia, with 77 peer-reviewed publications, he retired as Professor Emeritus from New Mexico State University in 2008. He is currently the founder and director of Global Change Consulting Consortium, a membership-based scientific consulting firm. In addition, he serves as Chairman of the Board of Trustees and Treasurer at Las Cruces Academy, Inc., a non-profit, private, non-sectarian school for gifted and advanced children.

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## EVENTS CALENDER

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### After-school STEM mentors needed

Manzano Mesa Elementary School (MMES), located near the Eubank gate, is looking for mentors for its volunteer program whereby professionals of diverse fields can provide students with math, science, and/or engineering experiences and skills through the MMES Sandia Science Club. This after-school club runs Fridays, 3:45-5:15 p.m. for Grades K-5. Volunteers can help every week or just once a year. The students cherish any help that volunteers provide. This is a great opportunity for NMAS members to be role models and to train and encourage the next generation of professionals. If interested, contact Deanna Creighton Cook at: [Deanna.m.cook@gmail.com](mailto:Deanna.m.cook@gmail.com).

## Membership Form

### NEW MEXICO ACADEMY OF SCIENCE

New Membership 2013 [ ] or 2014 [ ] Renewal 2013 [ ] Renewal 2014 [ ] Publications [ ] Donation [ ]  
*(check all that apply)*

Date \_\_\_\_\_ Title \_\_\_\_\_ Name \_\_\_\_\_

Employer/Firm/Affiliation \_\_\_\_\_

Primary Interest (geology, astronomy, environment, education, etc.) \_\_\_\_\_

Mailing Address \_\_\_\_\_

Phone \_\_\_\_\_ FAX \_\_\_\_\_ email \_\_\_\_\_

Check if your address is different from that on the mailing label of this newsletter [ ]

#### NMAS Publications

<b>New Mexico Journal of Science</b>	\$10 _____
Set of all available pre-1992 back issues	
<b>From Sundaggers to Space Exploration</b>	\$4 _____
NMAS Sigma Xi, 1986	
<b>Dinosaurs of New Mexico</b>	\$10 _____
NMAS Journal vol. 32, 1994	
<b>The Importance of Agricultural Science in New Mexico's Economy</b>	\$10 _____
NMAS Journal vol. 34, 1994	
<b>Astronomy in New Mexico: Past, Present and Future</b>	\$10 _____
NMAS Journal vol. 35, 1995	
<b>New Mexico's Natural Heritage: Biological Diversity in the Land of Enchantment</b>	\$10 _____
NMAS Journal vol. 36, 1996	
<b>Environmental Management: Current and Future Needs</b>	\$10 _____
NMAS Journal vol. 37, 1997	
<b>Water Resource Issues in New Mexico</b>	\$10 _____
NMAS Journal vol. 38, 1998	
<b>Ensuring Sustainable Development of Arid Lands Through Time</b>	\$10 _____
NMAS Journal vol. 39, 1999	
<b>NMAS Journal vol. 40, 2000</b>	\$10 _____
<b>NMAS Journal vol. 41, 2001</b>	\$10 _____
<b>NMAS Journal vol. 42, 2002 (Centennial CD)</b>	\$10 _____
<b>NMAS Journal vol. 43, 2003</b>	\$10 _____
<b>Science on the Border (vol. 44, 2006)</b>	\$10 _____
<b>Energy in the Southwest (vol. 45, 2008)</b>	\$10 _____
<b>New Mexicos Water Resources (vol. 46, 2012)</b>	\$10 _____

Subtotal: \$ \_\_\_\_\_  
 + Handling: \$ 2.00  
**TOTAL: \$ \_\_\_\_\_**

#### Membership Class (check one)

- |  |           |
|--|-----------|
| <input type="checkbox"/> Member                            | \$25/year |
| <input type="checkbox"/> Student                           | \$15/year |
| <input type="checkbox"/> Life                              | \$400     |
| <i>(3/4 of amount goes to NMAS Endowment)</i>              |           |
| <input type="checkbox"/> Subscription                      | \$30/year |
| <i>(Libraries only)</i>                                    |           |
| <input type="checkbox"/> Contribution to NMAS Endowment    | \$ _____  |
| <input type="checkbox"/> Contribution to NMAS General Fund | \$ _____  |

Membership subtotal: \$ \_\_\_\_\_

Donation subtotal: \$ \_\_\_\_\_

Publication subtotal: \$ \_\_\_\_\_

**Total: \$ \_\_\_\_\_**

Membership includes newsletters and occasional special Journal of Science volumes (sent to life members and members who have paid their annual dues during the volume's year of publication).

Send checks, payable to NMAS, to:

New Mexico Academy of Science  
 1801 Mountain Rd. NW  
 Albuquerque, NM 87104

**Voting Ballot:** Please fill out the following ballot for the 3 board positions and the 12 proposed bylaws amendments, and mail back this entire page to NMAS (keep your mailing address label attached too please). While you're at it, complete your 2014 membership form on the previous page and send us both together before Nov. 9! Further information on the candidates can be found on pages 5-6, and bylaws details on our webpage <http://nmas.org/>.

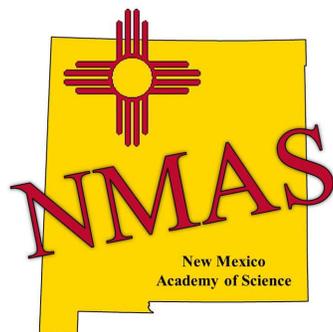
\_\_\_\_\_ Officer Candidates \_\_\_\_\_

- 1. Vice President (*select one*)  
 Shanalyn Kemme [ ] Hartono (Anton) Sumali [ ]
- 2. Director-at-Large (*select one*)  
 Hal Behl [ ] Jim Murphy [ ]
- 3. Treasurer  
 Vincent Gutschick [ ]

\_\_\_\_\_ Bylaws Amendments \_\_\_\_\_

- 4. Correct all spelling and grammatical errors.  
 Accept [ ] Reject [ ]
- 5. Delete obsolete language and practices.  
 Accept [ ] Reject [ ]
- 6. Add clause for conflict of interest.  
 Accept [ ] Reject [ ]
- 7. Add clause for indemnification.  
 Accept [ ] Reject [ ]

- 8. Add language to allow for electronic notification of all meetings and electronic ballots in all elections.  
 Accept [ ] Reject [ ]
- 9. Add language to allow Board meetings by conference telephone or similar methods.  
 Accept [ ] Reject [ ]
- 10. Add secretarial duty of recording all balloting and decisions by the Board during electronic meetings/actions.  
 Accept [ ] Reject [ ]
- 11. Add language to allow electronic voting by NMAS members during elections and amendments to bylaws.  
 Accept [ ] Reject [ ]
- 12. Add language to clarify appointment of Directors with Board approval.  
 Accept [ ] Reject [ ]
- 13. Add language to allow for action without a meeting by electronic communication.  
 Accept [ ] Reject [ ]
- 14. Add positions of Director Emeritus and Associate Director to the Board.  
 Accept [ ] Reject [ ]
- 15. Change term of Secretary and Treasurer to 2 years.  
 Accept [ ] Reject [ ]



New Mexico Academy of Science | Newsletter

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