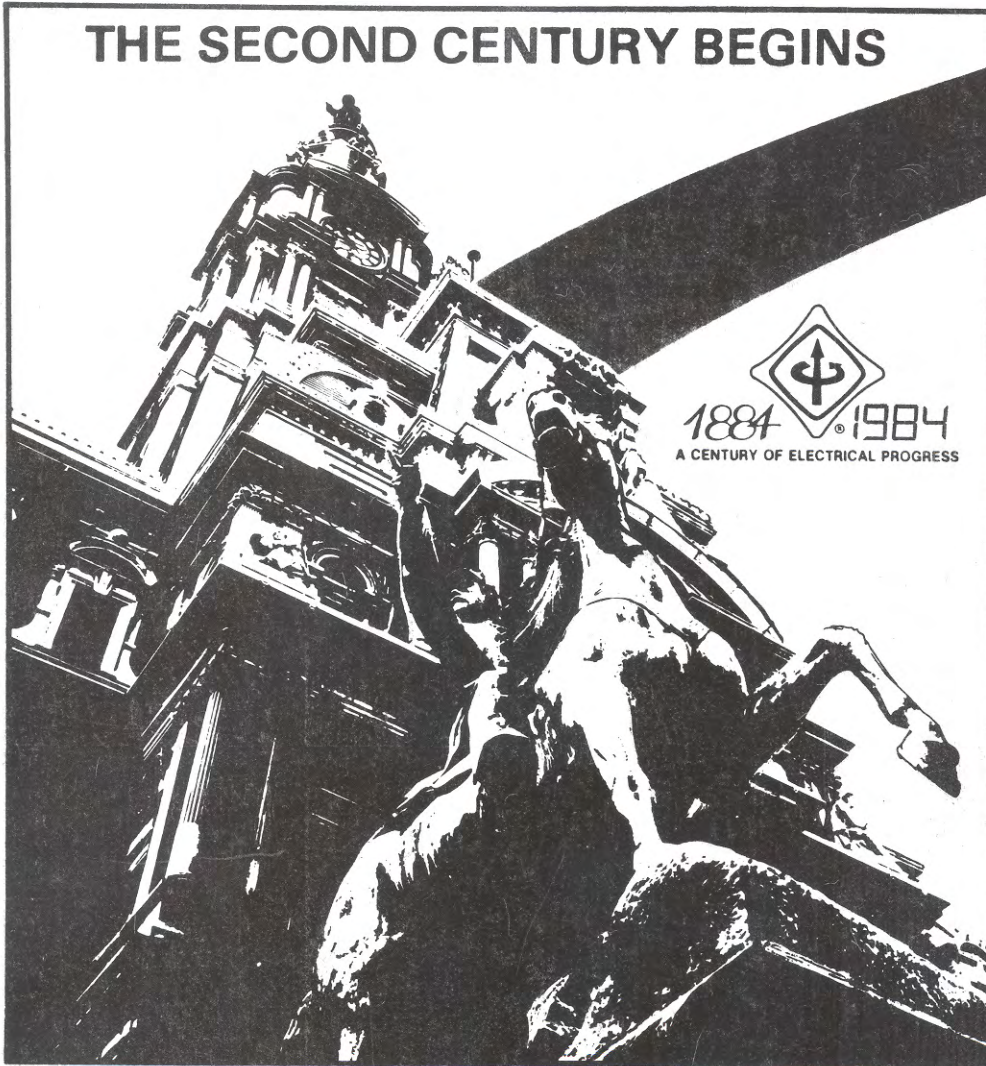


# *western engineer*

Volume 68, Number 10

OCTOBER 1984

## THE SECOND CENTURY BEGINS



See Page 11



## RockIEEE Overlook

See Page 10



# PRESIDENT'S MESSAGE

James M. Dougan  
President — Colorado Society of Engineers



Our October all-member meeting will be a **LUNCH** meeting on October 2nd. Our speaker will be from Norad talking about their facilities. The Golf Tournament (Part B) was a huge **success!!** Congratulations and thanks for organizing to Melissa Browning-Sletten, Walt Howat and John Kreiling. It was a fun afternoon.

There's an air of excitement as the other societies as well as ours gear up for the coming year. I'm heartened to see the level of commitment of the volunteers for this year's activities. Drawing on their optimism and enthusiasm "This is going to be a great year". **KEEP GOING TEAM!**

We've had a few members request consideration be given to a December Christmas Party. Some of the Board

kicked the idea around and have asked for feedback from the general membership. The thinking was to have the party between Christmas and New Years and to have a small business meeting to handle the business of the nominations committee. This gives us one meeting for December and January versus no meetings. It gives us all one less party to sandwich in between Thanksgiving and Christmas, and perhaps in the aftermath of the holiday season we'll be better able to appreciate the quality of the company. Let us know your druthers.

We haven't heard much from you for or against the EIT/PE Exams Training Session, Career days involvement, or Math Counts Program. Please speak out!! Apathy is the only think worse than lethargy. Annon.

Hope you made and enjoyed our September program and I trust we'll see each other in October.

## THE MAGIC INGREDIENT

*Reprinted from FRONT•LINE, July 1984*

It's as elusive as a shadow.  
As fragile as an egg.  
Those with it excel.  
Those without it expire.  
You can only get it  
by giving more of yourself.  
You can't achieve it  
by yourself.  
Like the Tango,  
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With it,  
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in Super Bowls,  
in business.  
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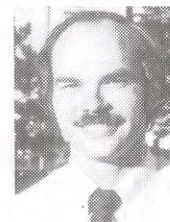
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each month for the following month's  
issue.

# CHAIRMAN'S MESSAGE

By John B. Richards, Chairman IEEE Denver Section



**FOR SALE** There are still plenty of Centennial tee-shirts and hats available. If you want one, please contact any member of the Executive Committee who works near you to make arrangements for picking one up. They cost \$5.00 each. If you are a student and wish to make some money for your student branch, the Denver Section will let you have them for our cost, and we will also let you have them on credit. Give me a call at 329-1177 for details.

**SATELLITE VIDEOCONFERENCES** If you noticed several satellite videoconferences that were advertised in **The Institute**, you may have wished to

attend some of them. The Denver Section has participated in the conference on Robotics. We can also participate in any of the advertised conferences. They include: October 8, 1984 "VLSI-Its Impact on Your Career", December 4, 1984 "Integrated Manufacturing Systems". The cost will be about \$75.00 if 12 or more people are registered. IEEE will also sponsor a 'free' videoconference on October 8, 1984 "The Second Century Begins" with panelists Joshua Lederberg, Alvin Toffler and Charles Townes. This conference will be at 6:30 PM local time. Please see the meeting announcement in the ROCKIEEE Overlook Section of this issue for details.

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# STATE BOARD REPORT

by George D. Sellards, P.E., L.S.

Chairman — State Board of Registration



## New Board Members Appointed

This past June, Governor Lamm appointed two new members and reappointed one member to the State Board of Registration for Professional Engineers and Professional Land Surveyors. The new members are Felix W. Cook, Sr., P.E., and Arthur J. Kidnay, P.E. Harold (Jay) Seitz was reappointed for a second term. Both Mr. Cook and Mr. Kidnay bring excellent credentials to the Board and have been initiated into the review of applications, interviews and matters of Board concern.

Felix W. Cook, Sr., P.E. of Lakewood is an electrical engineer who holds the position of Head, Power System Section

with the Bureau of Reclamation. Felix holds a B.S. degree in Electrical Engineering from Southern University in Baton Rouge, Louisiana and Master of Public Administration degree from the University of Denver.

Arthur J. Kidnay, P.E., of Arvada, is a chemical engineer and is currently Head of the Department of Chemical and Petroleum Refining Engineering at the Colorado School of Mines in Golden, Colorado. Art holds a degree in Petroleum Refining-Engineering from the Colorado School of Mines, an M.S. in Chemical Engineering from the University of Colorado and D. Sc. in Chemical and Petroleum-Refining Engineering

from the Colorado School of Mines.

Jay Seitz, who remains on the Board and serves as one of its two public members, remains vice president of the Board and Secretary to the Survey Quorum.

We are certainly pleased that the Governor has chosen Felix and Art to carry on the work of our departing Board members. Kenneth R. Wright, P.E., and William J. Hanna, P.E. have now completed their terms on the Board and they did so with distinction.

Ken Wright, P.E. was first appointed to the Board in 1975 and served as Board chairman in 1980. Bill Hanna was first appointed in 1973 and served as the Board chairman in 1981 and 1982. It is impossible to accurately quantify the time and energy that Ken and Bill gave to their work on the Board, but it is obvious to those of us who had the pleasure of observing and working with them that their efforts were worthwhile in many ways.

Thanks, Ken Wright. Thanks, Bill Hanna — from all of us.

## ON THE LIGHT SIDE

### KNOW NEWS

There is something I don't know that is keeping me from being boss but I don't know what it is?

My boss knows what it is because "he's boss!"; and even though he tells me everything I don't know, I don't know if he's told me what I don't know that is keeping me from being boss, since I don't know what it is?

I try to know what I don't know by taking: advanced engineering courses,

management training courses, even speech courses, but I still don't know what I don't know that is keeping me from being boss.....or I'd be boss! So to be sure I get to know what I don't know, I find myself working hard to know.....EVERYTHING

(Time passes On By Degrees)

Now I'm too old to boss, but now I know what it was I didn't know that was keeping me from being boss..... IT WAS THE BOSS!

### ENGINEERING TEAM

The process group feels the project group is stupid because they are always asking questions. The project group feels the process group is stupid because they don't have all the answers to their questions.

Both groups despise one another yet they both know if the one stops asking questions and the other stops giving answers they will both be out of work.

Both groups are always complaining about their lot since they feel it's a terrible life when your work depends on.....STUPID PEOPLE!

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## CSU PROF HONORED FOR CHEMISTRY BREAKTHROUGH

Colorado State University chemistry professor Albert I. Meyers has received two prestigious awards for pioneering work that helped scientists create such safe, inexpensive drugs as antibiotics, tranquilizers and cardiovascular medicine.

The breakthrough duplicates the way nature makes optical isomers, the specific molecular arrangements in enzymes, pharmaceutical drugs and other biologically important chemicals. First observed in 1975 in Meyers' CSU laboratory, the breakthrough capped a long, tedious research effort by scientists worldwide.

"Before we learned how to make the single optical isomer — this process is called asymmetric synthesis — there had been 100 years of research going into this field, and it all had been essentially futile," Meyers said. "I always told my students who helped with the research that Mother Nature was laughing at us because she could make the correct optical isomer and we scientists couldn't."

Meyers will receive the American Chemistry Society's Award for Creative Work in Synthetic Organic Chemistry at the society's awards banquet April 29, 1985, in Miami Beach, Fla. The award, although given through the largest chemical society in the world, is sponsored by the Aldrich Chemical Company, Inc. The award consists of a \$3,000 stipend and certificate. The award, given to only one organic chemist annually, was announced at the society's headquarters in Washington, D.C.

Meyers also recently received the Alexander von Humboldt-Stiftung Senior U.S. Scientist Award, presented annually by the German government to American scientists in various research fields.

The award allows for a stipend to pay for a six-month sabbatical to lecture in Germany. Meyers, his wife and two daughters intend to spend four of those months there from early September through December and two months at a later date.

Both awards recognize accomplishments in creative research and teaching.

In addition, Meyers has been asked to be one of 25 international guest lecturers on the field of synthetic organic chemistry at the Nobel Foundation's Chemistry Symposia, beginning Sept. 2 at the Alfred Nobel Palace near Stockholm, Sweden. The symposia is designed to determine if a Nobel Prize should be awarded in that area of science in the near future.

In simple terms, Meyers' optical isomer research, conducted with the aid of 75 of his graduate and post-doctorate students over a development period of the last five years, found a way to easily duplicate a single optical isomer, which is produced naturally in human bodies and other organic materials.

Scientists have known for years how to create an optical isomer with mirrored parts, but those parts require separation. The double parts have minimal — or even harmful — effectiveness in a

**Continued on page 7**

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# UNCLE JOHN'S FILE

by John C. Kreiling, P.E.



Did you miss the column last month? Thought sure there would be a guest writer, so with that in mind we enjoyed our sojourn through Ireland, Wales, Scotland and England — more on the trip later. Upon our return, the door had hardly closed and here was a call — the adjourned golf tournament was about to begin and my presence was necessary. It was truly an ideal Colorado day sunshine, moderate temperature, no wind and a very convivial group. Alas! I lost my camera with the film shot of all the four-somes — some thirty-four players, hope I shall be forgiven. Forrest Scruggs will again have his name engraved on the cup plaque as the Society Member with the lowest gross score, the winners were:

1st Low Gross	Ron Betz
2nd Low Gross	Forrest Scruggs
3rd Low Gross	Dave Serles
4th Low Gross	Bruce Nielsen
1st Low Net	Bob Kenney
2nd Low Net	Bob Woodard
3rd Low Net	Eric Rindahl
4th Low Net	Bill Biggi
Closest to Pin	Clyde Van Iwarden
Longest Drive	John Boring
Most Fun	Lloyd Weide

To those who paid for the supper which was not served, call on secretary Roberta for refund. An ever changing lineup of players Don Sutherland and Herb Woodard other than Forrest Scruggs are the only players, that I remember from twenty years or more ago competition. Such participants of the past as Dumler, Blair, Colasanti, Akerlow, Art Peterson and Harold Peterson, I miss you all and oh yes! Lou Cummings of years past is still competing.

Walt Howat was on surgical leave, talked to him this Saturday before Labor Day, he had just come in from nine holes of golf, his first in over a month of layoff — great to know of his progress.

Jack Dynan has retired from Midwest Steel & Iron Works Co. — now Mid-

westeel, will have more next issue. Dan Harrington is building an addition to the family ranchhouse near Tincup, believe Dan told me his grandfather was the original owner — hope to get an opportunity to see the layout.

Linn Hart, a former member of the Society was up from Havasu City, Arizona. Our lunch discussion with Chet Andersen and Adolph Zulian included recollection of Society Annual Meetings at the Shirley Savoy and Cosmopolitan Hotels — even the Brown Palace. Those were the days when there were seven hundred and more at the Saturday Night Stag Dinner and Show.

Haven't had a birth to report in a long time — our Jeannie in Roberta's office should have something to tell us by next column writing. **PLEASE LET ROBERTA KNOW OF EVENTS IN YOUR LIFE FOR PUBLICATION** — it is very dull for me researching for trivia and the like to fill the column, when there are eventful happenings which we all would enjoy hearing about and publishing.

Now a bit of pleasantries of Ireland, Wales, Scotland and England our recent trip.

## IRELAND

Again I kissed the Blarney Stone to bolster my story stretching ability — my maternal ancestors came from Northern Ireland. Antrim County to the north of Belfast, so am eligible for all the benefits available upon standing upon my head to kiss the stone. You have all heard of "grog," a ration (daily) originally of rum. The source of the word "grog" goes back to 1740 when Admiral Edward Vernon of the British Navy ordered ship of the Caribbean fleet to dilute the daily rum ration with water. Vernon's nickname was "Old Grogam" — a name derived from the fact that he wore a cloak made from a coarse cloth called grogram. Thus it was fitting that "Old Grogam's" brew of rum and water should be called "grog".

From Old Granny's  
St Patrick's Day Cookbook

## Irish Stew

- 1 lb. stew meat
- 1 lb. potatoes
- 2 carrots
- 2 gallons whiskey
- 1 quart of beer
- 1 pint gin

Cut up potatoes and carrots, add to meat. Pour the remaining ingredients over them and cook for three hours. Dump out the first three items and drink the gravy.

## The Shamrock

Mix together 1 quart of beer, 1 quart parsnip wine and 1 quart of Irish Whiskey drink. Don't worry if you turn green and sick — you'll be lucky you're still alive.

## WALES

I learned we left handers are referred to as "citheogs" a slang word. Years ago, as was brought over to America a left hand person was considered possessed of evil, I know, for the sisters at St. Clara's orphanage broke me of writing with my left hand.

## SCOTLAND

We ate blood pudding and haggis. Also enjoyed our tour of the castle at Stirling — between Glasgow and Edinburgh, the home of Queen Mary of Scotland and her son James. James I followed Queen Elizabeth I as King of England and Scotland, the unification of the two countries is attributed to him. Also, the American settlement Jamestown, Virginia was named in his honor.

## ENGLAND

In London it is a traffic violation to blow an automobile horn. We also heard more of the Big Band Era music of American origin on TV and radio during the four days we were there and in a month or more at home — such harmony. Also, after returning home, we heard numerous people complain of the Olympic telecast favoring American participants — the same thing occurred in London — all of United Kingdom medal winning events were shown, little of other nations — so all is the world over, likewise.

Incidentally, while in Dublin we visited the Irish Sweepstake headquarters — I have a picture of the raffle ticket mixing drum — it is twenty feet long and ten feet in diameter more or less.



## CSU PROF HONORED

Continued from page 5

drug because one side typically is inactive or toxic when used in medical treatment.

Until the research at CSU, scientists used an expensive, laborious process to separate the mirrored parts.

"Every pharmaceutical drug on the market has to have the right optical isomer, or our bodies won't respond positively to it," Meyers said. "If laboratory-made penicillin, for instance, has a mirrored isomer, 50 percent of it is often going to be inactive, requiring twice as much of the drug, or, worse, it will be toxic to humans."

"The process we developed allows chemists and pharmaceutical laboratories to easily prepare molecules for medical use and further study, without the disadvantage of having to first separate the optical isomers."

Although the optical isomer research was done at CSU, it was funded by the National Science Foundation and National Institutes of Health. Over a

decade the research provided about \$1.2 million in revenue for overhead expenses for the university.

Worldwide, research into developing purely synthetic compounds is in the infant stages. Moreover, some scientists have become frustrated because of the complexity of duplicating nature's molecular activity.

The players in this activity — the molecules — are well-known to scientists in terms of their location of atoms and bonding characteristics. However, the bugaboo arises in determining the exact combination of chemical reactions that duplicate to create a compound similar to one made naturally.

But as generic duplication processes, such as the one developed at CSU, are discovered for natural compounds, substantial breakthroughs are being made in drugs used for anti-cancer, cardiovascular and other medical treatments.

Meyers, considered one of the more popular, energetic CSU professors, came to the school 12 years ago from

Wayne State University. He also has taught at Louisiana State University.

In Colorado, one of his early research efforts was aimed at finding an anti-cancer drug by synthesizing molecules of Maytansine, a compound produced by nature in a rare plant in Africa and South America.

Substantial progress was made in the area of chemical achievement, but no medical breakthroughs on the anti-cancer drug had been made by the time the CSU research ended in the early 1980s. Medical researchers at other institutions are continuing the study of the synthesized Maytansine molecule developed at CSU.

In connection with Maytansine research, Meyers was in 1982 given an award from Britain's Royal Society of Chemistry. He also has been an honorary lecturer for the French and British chemical societies, and a Japanese Science Foundation fellow. He is currently one of the editors of the Journal of the American Chemical Society, the most prestigious chemical journal in the world.



# Don't Overlook Overhead Lines

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## THE BIRTH AND GROWTH OF ELECTRICITY IN COLORADO

By Lawrence M. Robertson  
Vice President of Engineering and Construction,  
Retired Public Service Company of Colorado

### Central Colorado Power Company

The Central Colorado Power Company was founded in 1906 by Myron T. Herrick, later Governor of Ohio and ambassador to France. He had some ideas regarding very extensive hydro-electric power and transmission development.

### Shoshone Plant

Herrick had a vision of a "Run-of-River" plant on the Colorado River in the Glenwood Canyon at Grizzly Creek. A storage dam and reservoir could not be built there as the railroad was there but a flow of 1250 sec./feet could be sustained by storage dams in the Gore Canyon and Williams Fork.

An earth-depression occurred in 1907 and the site for the plant was moved upstream as a temporary mea-

### THE ADVENT OF HYDRO-ELECTRIC POWER GENERATION IN COLORADO

sure, to the present Shoshone, about eight miles east of Glenwood Springs. Construction was started in 1906 and a diversion tunnel to divert water from the river by a "bear trap" collapsible diversion dam in the river. The tunnel (Fig. 9) is two and one-third miles long, through the granite side of the canyon to a forebay, spillway and two penstocks, 9 feet in diameter, with 175 foot/head to the two generators of total capacity of 10,000 k.w. This has been increased to 14,400 k.w. The plant also includes horizontal twin, inward flow Francis turbines. The machines started generating on May 24, 1909.



Figure 9. Diversion tunnel carrying water from the Colorado River to Shoshone hydroelectric plant. This tunnel is 2½ miles long and was bored through the granite wall of the canyon.

### Shoshone-Denver Line & Its Operation

The Shoshone-Denver line and its operation is unusual in many ways from other lines in the world because of the high altitude and severe conditions of the weather and terrain. The line starts at Shoshone Plant with an elevation of 6,000 feet and terminates in Denver at 5,280 feet. In the 154 miles it passes over the Continental Divide three times: the highest elevation being at Argentine Pass at 13,532 feet, the others at Hagerman Pass at 12,000 ft. and Fremont Pass at 11,300 ft. The average elevation of the line is 10,000 feet.

Construction started in late 1906 and was completed in early 1909. The route of the line was near towns where mining was active and along railroads wherever possible. It was accomplished in a very short time, considering that it was done with only manpower and animals. Schemes were devised for expediting the job, such as a method of



Figure 10. Construction in 1908 of Shoshone-Denver 90 k.v. line on top of Argentine Pass, 13,532 feet in altitude, with Argentine Peak at 13,700 feet in the background.



erecting towers such as the top tower on Argentine Pass, Figure 10.

The heavier towers were used in higher altitude for the severe loading and the standard A-frame towers for the remainder. All had to be guyed where there was heavy loading.

The conductors were No. 9 hemp-center copper in heavy loading areas and the remainder were No. 1 hemp-center copper with phase spacing of 10 feet, 4 inches.

The Boulder Hydro-Denver line was 27 miles long and had the lightest towers and No. 1 conductor. There were about 1,400 towers, with an average span of about 730 feet, and maximum of 2,500 feet. Two overhead ground wires were installed on the Denver-Boulder line and five miles on each side of all substations on the Shoshone line, and Leadville and Dillon substations, and over Argentine and Hagerman Passes. It was clamped to the top of the cross arm on top of the tower by mechanical

the insulators needed protection by a shorter air gap. Designs were made of a saddle clamp for suspension with arc horns for the bottom and the top of the string to decrease the air gap by one insulator. One insulator was added to all strings (Figure 11).

Studies had been made on corona loss at low altitudes, and it was decided to use a conductor with a larger diameter than the size needed for the load, hence the use of hemp-center, 6 strand copper.

In later years, failures of conductors occurred that were not burned in two, but the ends of the strands of the copper were square breaks and not necked-down as in tension. Opinions were received from five manufacturers with various theories — impurities, nicks by dies, or dull dies. It was noted that the end of the strands had a dark, half-moon color where the strand had been in contact with the hemp.

The line was in corona and ozone

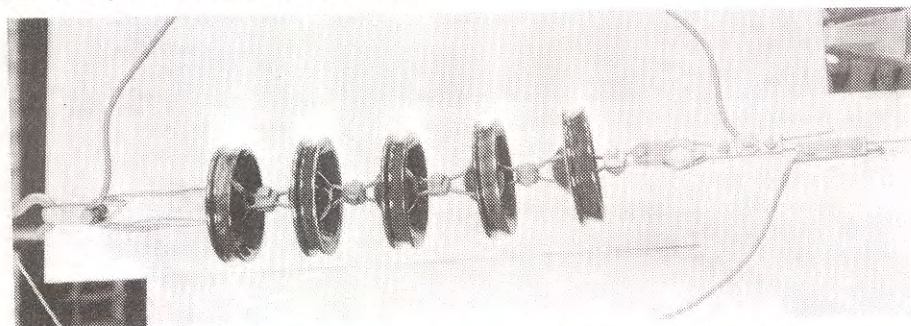
could form and the hemp could hold moisture to form acid which attacked the copper. In any event, these failures were frequent and conductors were replaced.

Argentine Pass, being the highest, has the most severe temperature conditions with sleet loading, wind, and lightning. Thus more failures occurred here, and a three-mile emergency or bypass line around the top section of the line was built with disconnecting switches at each end.

A wind gauge installed on Argentine Pass to indicate velocities of up to 165 miles per hour was subsequently blown away. A specially prepared board, 12 inches square suspended by a 50-lb. spring balance was next experimented with to get a basis for wind-pressure calculations. However, the wind quickly wrecked this apparatus. The wind is so strong on Argentine Pass that line patrolmen on the summit had to lash themselves to the steel towers to prevent being blown away during a storm. One man's dog, not so fortunate, was actually picked up like a leaf by the wind blast and was blown far out over the side of the mountain, never to be seen again.

Snow slides or avalanches were a serious problem in a number of areas where the line transversed steep mountain slopes and often these slides caused total destruction. A steel tower in the path of the slide forms a dam and will catch trees, brush, rocks, snow and debris brought down by the slide with

Continued on page 16



**Figure 11. Hewlett insulator string, originally of five units in dead ends and four in suspension, these were increased by one insulator in about two years. Arc horns were added at the same time. Suspension clamps were designed with horns and replaced the original.**

clamps.

Reports were received of sleet of six to 10 inches in diameter on the conductors on the passes. Towers, conductors and insulators were replaced on Argentine and Hagerman Passes with greater strength items.

Insulator strings were made up of 10-inch Hewlett discs with links through the porcelain to join them together. There were four units in suspension and five in dead-ends with a simple bolted clamp in suspension, and the conductor at dead ends looped through a guy thimble and held with a link and three-bolt clamp. This was all that was available.

It was found that electrical failures occurred at the insulators and that puncture voltage and flash-over voltage was about the same. It appeared that the clamps were not correct and that



**Figure 12. Barker Dam and reservoir near Nederland for the Boulder Canyon hydroelectric plant on Middle Boulder Creek. Altitude 8,188 feet. The Continental Divide is in the background.**





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# RockIEEE Overlook

## CHAPTER'S COLUMN

By Mike Foley, Group's Chairman, Denver Section

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Take a moment to call me at 329-1592 to tell me you're interested in being part of the CONTROL SYSTEMS SOCIETY chapter.

## OCTOBER CHAPTER ANNOUNCEMENTS

### AES

Aerospace and Electronic Systems

For meeting information contact Henry Rackley at 977-7621.

### CS

Control Systems

For meeting information contact Dan Zwego at 497-2682

### EMC (Littleton)

Electro Magnetic Compatibility

For meeting contact Robert O. Loveland at 977-3817.

### EMB

Engineering in Medicine and Biology

For meeting information contact K.C. Rock at 394-8351.

### RELIABILITY

For meeting information contact Mike Jinnette at 538-3447.

### Joint APS/MTTS/GRS

Antennas and Propagation/Microwave Theory and Techniques/Geoscience and Remote Sensing

IEEE Denver-Boulder Joint Chapter Meeting

PROGRAM: Thermal Infrared Geophysics

SPEAKER: Dr. Kenneth Watson, U.S. Geological Survey

DATE: October 11, 1984

TIME: 4:00 p.m.

PLACE: Radio Building, Room 1103  
325 Broadway  
Boulder, Colorado

R.S.V.P.: Gary Olhoeft, 236-1302

Next Meeting: November 15.

### Joint COM/VTS

Communications/Vehicular Technology Society

For meeting information contact Bill Cheek at 235-0770.

### Joint COMPUTER/IT

Computer/Information Theory

PROGRAM: Applications Programs on Multi-Processors

SPEAKER: Dr. Harry F. Jordan, Department of Electrical & Computer Engineering, University of Colorado at Boulder.

DATE: Tuesday, October 16

TIME: 5:30 Social, 6:30 Dinner, 7:30 Program

PLACE: Holiday Inn, I-25 & 120th Avenue (tentative)

R.S.V.P.: For additional information and reservations contact Art Price, 538-4663, or Dan Michaels, 939-5139.

### Joint EMC/IM

Electro Magnetic Compatibility/  
Instrumentation and Measurement

For meeting information contact Paul Hardy at 499-6655.



# THE SECOND CENTURY BEGINS

## IEEE DENVER SECTION MEETING

IEEE-Franklin Institute Centennial Technical Convocation

Live, via Satellite

WHEN: **Monday - October 8, 1984**

6:30 - 8:30 p.m.

WHERE: **University of Colorado Medical Center**  
School of Nursing - Room 2939

PROGRAM: (see below for parking, building & room locations)  
**THE SECOND CENTURY BEGINS**

A two-hour Centennial Technical Convocation, live via Satellite, by the IEEE and the Franklin Institute, host of the first AIEE October 8, 1884, International Electrical Exhibition. Come join IEEE in another historical event. With over 100 locations participating, this will be the largest geographical technical meeting in IEEE's 100 year history.

The convocation will focus on the future, to assess likely developments and their implications for society. Following the addresses and responses, the panel members will answer questions phoned in by the various sections.

PRINCIPAL SPEAKER: **Bernard M. Oliver**, Technical Advisor to Hewlett-Packard Company. Recently retired as V.P. of R&D at H.P. He is an IEEE Fellow, past President of IEEE, elected to the National Academy of Sciences in 1973.

MODERATOR: **Edward E. David, Jr.**, President, Exxon Research and Engineering Company. Formerly Executive Director Bell Labs Research Communications Principles Division, Executive V.P. of Gould, Inc., Director of White House Office of Science and Technology, and Science Advisor to the President.

PANELISTS: **Charles H. Townes**, Professor of Physics at the University of California, Berkeley. Former Vice Chairman of the President's Scientific Advisory Commission, Chairman of the Scientific & Technical Advisory Commission, Nobel Prize for Physics in 1964.

**Alvin Toffler**, Scholar, Author, and Futurist. Currently a member of the International Institute for Strategic Studies. Published books include "Future Shock", "The Third Wave", and "Previews & Premises".

**Joshua Lederberg**, President of Rockefeller University. Currently a member of the National Academy of Science, U.S. Defense Science Board, Consultant to the Arms Cancer Panel. Former Nobel Prize winner in Physiology and Medicine for research in genetics in 1958. Turn east from Colorado Blvd. onto 8th Ave. Drive two short blocks (just past Ash Street to the south) turn north into a paved entrance with prepay parking meters (25¢ per hr. 24 hr.) along both sides of this entrance. To your left (across the street from Hoover's Restaurant) is parking lot H which is to be open for us this evening. (If not, parking is available on the side street south of 8th Ave. and there is an ALLRIGHT PARKING lot - 25¢ after 4:00 p.m. - just east of the CONOCO Station.)

BUILDING: Proceed north on this paved entrance, past the Motorcycle Parking area, along the east side of the "School of Nursing" Building. (The one just north of the Motorcycle Parking area with a yellow sign on it, about 15 feet above ground level, with "OLD CIRCLE DRIVE" written on it.) Walk up the stairs (or take handicap ramp), turn left and enter through the main entrance with "Henrietta A. Loughman" written over the doors.

ROOM 2939: Upon entering the "School of Nursing" main entrance, you will find the main entrance hallway to the left and a stair case to your right. Take the stairs (or the elevator around the corner) to the second floor and then enter the hallway to the south into the classroom and office area. The entrance to Room 939 is to your southwest around the corner along the 2nd inter east-west corridor to your right.



## ANNOUNCEMENTS

Continued from page 10

### Joint IAS/PES

Power Engineering Society/  
Industry Applications Society

**PROGRAM:** What is Forensic Engineering?  
An Overview and Case Studies

**SPEAKERS:** **John P. Nelson** - a Consulting Electrical Engineer engaged in the practice of what is referred to as "Forensic Engineering" - that of the application of technical engineering knowledge to the problems of the law. John will present a brief overview of what Forensic Engineering is all about.

**Jackson Fuller** - a Professor of Electrical Engineering at the University of Colorado and Consulting Forensic Engineer will present case studies via very interesting slides of electrical equipment gone astray. Jack has a most interesting and enjoyable presentation.

**DATE:** October 18, 1984

**TIME:** 6:00 P.M. Social Hour (optional)  
6:30 P.M. Dinner \$14.00 (optional)  
7:30 P.M. Meeting and Program.

**PLACE:** Clarion Hotel - Airport  
3302 Quebec (Quebec & Martin Luther King Blvd.)

**R.S.V.P.:** **MICHAEL FOLEY** Public Service Company of Colorado Telephone: 329-1592 No later than October 15, 1984 (for dinner or meeting only). If you are going to attend only the meeting, please call so space will be available.

## OCTOBER 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8 DENVER SECTION	9	10	11 APS/MTTS/ GRS	12	13
14	15	16 COMPUTER/ INFORMATION THEORY	17	18 PES/IAS	19	20
21	22	23	24	25	26	27
28	29	30	31			



**CALL FOR PAPERS**  
**IEEE VEHICULAR TECHNOLOGY CONFERENCE**  
**May 21 - 23, 1985**  
Boulder, Colorado

### EFFICIENCY, CONSERVATION AND PRODUCTIVITY

Papers are sought covering the full range of electronics in vehicular technology, with special emphasis on the following:

- MOBILE RADIO  
Planning Methodology
- NEW TECHNOLOGY
- DIGITAL COMMUNICATIONS
- CELLULAR RADIO -  
New Technology,  
Operating Experience
- SATELLITE MOBILE  
COMMUNICATIONS
- AUTOMOTIVE SYSTEMS
- TRANSPORTATION SYSTEMS
- PERFORMANCE MEASURES FOR  
MOBILE COMMUNICATIONS
- PERFORMANCE ASSESSMENT OF  
MOBILE COMMUNICATIONS
- COMPUTERS AND MOBILE  
COMMUNICATIONS
- MULTI-SERVICE FACILITIES  
COMMUNICATIONS
- FREQUENCY PLANNING AND USAGE
- ANTENNAS AND PROPAGATION
- GUIDED COMMUNICATIONS
- PAGING
- USER CONSIDERATIONS IN RADIO  
SYSTEM DESIGN

We also encourage papers for a special session on **Requirements: issues in Vehicular Technology requiring further research and development**. We are particularly interested in those topics which may not receive adequate attention in the course of commercial research and development.

Six copies of a 500 word summary should be submitted by November 1, 1984, to:

IEEE VTC 85  
Office of Conference Services  
University of Colorado  
Campus Box 454  
Boulder, CO 80310

Summaries should be typed single-spaced with a 2 inch left margin in a 4 1/4 inch column with a 1 1/2 inch top and bottom margin. The title, name(s), and affiliations should be included, with a complete address and telephone number.

Authors will be notified of acceptance by January 1, 1985. The complete text must be submitted by **March 1, 1985** and will be published in the 35th Vehicular Technology Conference Record which will be available at the conference.



## The Monday Blues: Don't Start the Week in the Pits

Reprinted from *FRONT•LINE*, July 1984  
Westinghouse Industries Marketing

Monday has a bad reputation. Most people would just as soon drop the day from the calendar altogether.

Monday mornings are the worst. You feel like you need a transfusion of coffee to stay awake. But even that wouldn't help. The cogs of your mind creak with rust. The world seems shrouded in gray.

Scientists tell us that there are perfectly good reasons for the Monday blues. The day of the week isn't to blame. Neither is just being back to work. We are to blame.

Actually, Mother Nature is the first culprit. Studies at Boston's Center for Design of Industrial Schedules have shown that nature gives us humans a biological sleepwake cycle of 25 hours. That is, a person living in a deep cave with no clock tends to go to sleep every

25 hours, not every 24. No one knows exactly why this is so.

Normally, our regular routine keeps us in sync with the 24-hour-a-day alarm clock. But on weekends, we let our schedule slide; we tend to slip back into the 25-hour pattern. We go to bed later and sleep later.

Then Monday rolls around and we're wrenched back into 24-hour days. Our internal clock takes some time to adjust. In a certain sense, we really are still "asleep" on Monday mornings.

But natural rhythms don't deserve all the blame. Many of us reinforce the Monday letdown by staying up even later on weekend nights and indulging in those extra hours of sleep on the mornings we don't have to be at work. And we may eat a little more and drink a little more than usual on weekends. That doesn't help. Neither does that vigorous Sunday softball game that

leaves us stiff and sore on Monday. It all adds up to the malaise.

The cure for the Monday blues is to stick as closely as possible to your weekday schedule on the weekends. Relax, have fun, but don't make a habit of being up until the wee hours or sleeping until noon on Sunday.

Moderation can help as well. Eat and drink wisely. Exercise, but don't overdo it. Pace yourself.

If you do find yourself out of sorts on Monday mornings, there are a few additional things you can do to cope with that blah feeling:

- Get more work done on Friday so that you don't have a pile waiting for you the first thing Monday. If you can, schedule something light and easy to start off the week.

- Eat a good breakfast. A University of Iowa study showed that those who take only coffee in the mornings are definitely more sluggish than those who eat a balanced breakfast. And go easy on

Continued on page 22

## The Institute of Electrical and Electronics Engineers

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**Membership** — Ezra Larsen, National Bureau of Standards, 497-3540  
**Colo. Engr. Council Rep.** — John Nelson, Nelson Engineering Inc., 431-7895  
**Colo. Engr. Council Alternate** — James Hart, Hartec Inc., 795-2813

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**Engineering in Med. & Biology** — K. C. Rock, University of Colorado Health Sciences Center, 394-8351  
**Aerospace & Electronics Systems** — Henry Rackley, Martin Marietta Aerospace, 977-7621  
**Reliability** — Ron Watts, Ford Aerospace, 471-9110, ext. 4151  
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**Joint EMC/Instrumentation & Measurement** — Paul Hardy, Hewlett Packard, 499-6655  
**Joint Communications/Vehicular Tech** — Bill Cheek, Skyswitch Satellite Comm. Co., 235-0770  
**Joint APS/MTTS/GRS** — Dr. Gary Olhoeft, U.S. Geological Survey, 236-1302



## ACM

Association for Computing Machinery.  
**Denver Chapter:** For information, call 695-3766.

**Boulder Chapter:** For information, contact Joe Lachman at 538-3872.

## ACSM

American Congress of  
Surveying and Mapping.

October - No meeting this month. Coming up in November - Survey Control for Developing Geographical Information Systems. For further information contact David Ferebe at 799-1071.

## AEG

Association of Engineering Geologists.  
Monthly meeting, October 1st. For more information, contact Mike West at 972-2706 or Susan Steele at 623-2500 ext. 547.

## AICHE

American Institute of  
Chemical Engineers.

October - For information, contact Denise Goddard at 692-4185.

## AIME/SME

Society of Mining Engineers  
of the American Institute of  
Mining, Metallurgical and  
Petroleum Engineers.

October 9th - Holiday Inn West (West Colfax & I-70) at 6:00 p.m. This will be a joint meeting with the Extractive Metallurgy Chapter of Denver and the Colorado School of Mines. The guest speaker will be Dr. Paul Queneau. For further information and reservations, contact Howard Harlan at 740-5379.

## AIME/SPE

Society of Petroleum Engineers  
of the American Institute of  
Mining, Metallurgical and  
Petroleum Engineers.

October 10th - Breakfast meeting at 7:15 a.m. Marriott Downtown. The speaker will be Nancy Reeves, with Halliburton. Her topic will be "Cement Quality Evaluation." For information and reservations call Wanda Reh at 573-8641.

October 24th - Luncheon meeting at 11:30 a.m., location to be announced. Speaker will be Joe Poole, with Schlumberger on the topic of "E.P.T. Logging" for further information and reservations call Wanda Reh at 573-8641.

## AIPE

American Institute of Plant Engineers.  
For information, contact Bill Riddle at 534-8181.

## AIPG

American Institute of  
Professional Geologists.

Monthly luncheon meeting, October 15th at the Denver Press Club. The speaker will be Dr. Bob Alexander of the University of Colorado-Institute of Behavioral Sciences. His topic will be "Digital Cartography." For reservations, call 534-3667 by Thursday, October 11th.

## ASCE

American Society of  
Civil Engineers.

**Colorado Springs Chapter:** Monthly meeting, October 18th. Cocktails 6:00, dinner 6:30, and program to follow. The speaker will be Dick Sparlin with Centennial Engineering. His topic will be "Engineers... a Profession." For location and further information, contact Jane at 471-9960.

**Western Chapter:** For information, contact Dave Sorenson at 320-6400.

## ASHRAE

American Society of Heating,  
Refrigeration and Air Conditioning  
Engineers.

Monthly meeting, October 3rd. Cocktails at 5:30, dinner at 6:30, and program at 7:30. To be held at Rossi's, 4301 Brighton Blvd. - Denver. The speaker will be Mr. Robert Gyepes, P.E. of the Design and Construction Division, General Services Administration. His topic will be "Chilled Water Systems." For information, contact Gary Shaffer at 232-6200.

## ASME

American Society of  
Mechanical Engineers.

For information, contact Rob Hampel at 797-2455.

## ASPE

American Society of  
Professional Estimators.

October 9th - Holiday Inn North (I-25 and 48th) 6:00 p.m. social, 7:00 p.m. dinner, program to follow. Members cost \$12.00. For reservations and further information, contact Lynn at the ASPE office, at 458-0465.

## ASSE

American Society of Safety Engineers.

October 8th - Luncheon meeting at 11:30 a.m., Inn At The Mart (I-25 & 58th) Program topic: "Accident Investigation Using Photography." Speaker will be from Fay Engineering. For reservations & further information, contact John Mayerle at 740-1680.

## CCSSE

Colorado Chinese  
Society of Science and Engineering  
(formerly CCEA).

October - No meeting this month. The next meeting will be in November for information, contact Dr. Paul Cheng at 977-1871.

## CEC

Colorado Engineering Council.

Monthly meeting, October 10th. Cocktails at 6:00, dinner at 6:30, and program at 7:30. To be held at the Landmark Inn. For more information, contact Dave Sveum at 234-6478.

## CECC

Consulting Engineers  
Council of Colorado.

Board of Directors meeting, October 23rd at 3:30 p.m. To be held at the DAC. General meeting to be held on October 23rd. Cocktails at 5:30, dinner at 6:30, and meeting at 7:30 p.m. For information, call the DAC office at 757-3379.

## CSA

Colorado Safety Association.

Events for October include:

9th-10th — Defensive Driving Course — Open to the public. Evening classes 5:30-9:30 p.m.

24th — DDC - 8:00 a.m.-5:00 p.m.; Open to the public.

25th — Drinking, Driving & You, 8:00-10:00 a.m.; Open to the public.

26th — DDC II — 8:00 a.m.-12:00 noon; Open to the public.

24th-25th — DDC Instructor Development Course.

28th — DDC II Instructor Development Course.

29th — Nov. 2nd - Occupational Safety Management (NSC)

For more information, contact Rodney Williams at 629-6255.

## CSE

Colorado Society of Engineers.

Lunch meeting, October 2nd. To be held at the Landmark Inn. Cocktails at 11:30, lunch at 12:00 and program at 12:30 p.m. The speaker will be John Simmance of Vibra-Tech. His topic will be "Ground Motion in the Courts." For reservations, call the CSE office at 426-5228 by October 1.

## DFCPEG

Denver Federal Center

Professional Engineers Group.

General meeting, October 17th. Cocktails at 11:30. To be held at the Denver Federal Center, Bldg. 56, Room 2017. The speaker will be Phil Burgi of the Bureau of Reclamation. His topic will be "Glen Canyon Dam Spillway Modifications." For more information, contact Floyd Summers at 231-1147.



Extractive  
Metallurgy  
Chapter of  
Denver

(ASM-AIMR/SME)

October 9th - Holiday Inn West (West Colfax & I-70) at 6:00 p.m. This will be a joint meeting with AIMR/SME and the Colorado School of Mines. The guest speaker will be Dr. Paul Queneau. For further information, contact Howard Harlan at 740-5379.

## IEEE

Institute of Electrical and  
Electronics Engineers.

Meeting notices begin on page 10 of the RockIEEE Overlook Section of this issue. For additional information contact Craig Hartman at 987-4256.

## ISA

Instrument Society of America.

October 4th - Quality Inn (I-25 & Speer Blvd.) Social at 5:30 p.m., dinner at 6:30 p.m., program to follow for further information contact Guy Bigalow at 741-7341.

## PEC

Professional Engineers of Colorado.

**Boulder Chapter**

October 10th - University Memorial Center (UMC) Broadway & Euclid, in Boulder. Social hour 6:30 p.m., dinner 7:00 p.m., program to follow. The program will be "The Design & Construction of Bridges" by Joe Meheen. For reservations & further information contact Bob Corning, 530-1451 or Dallas Fowler, 494-4943.

**Comanche Chapter**

October 20th - Details to be announced. For further information, contact Charles Tucker at 384-7787.

(days) or 384-6613 (evenings).

**Jefferson Chapter**

October 11th - Bernard's Restaurant, 5390 Wadsworth Bypass. Cocktails at 6:15 p.m., dinner at 6:45 p.m., program to follow. For further information & reservations, call the PEC office at 458-0465.

**Metro Chapter**

October 17th - Quality Inn, 2601 Zuni St. 6:00 p.m. to 7:00 p.m. cocktails & dinner, program to follow. For further information, call the PEC office at 458-0465.

**Northern Chapter**

October 18th - For details and reservations, contact Mike Ketterling at 351-0550.

**Pikes Peak Chapter**

October 9th - For details and reservations contact Gregory Smith at 473-2300 x774.

**San Juan Chapter**

October 18th - Contact Gerald Zink for information and reservations at 259-2869.

**Southern Chapter**

October 3rd - LaRenaissance in Pueblo. 6:30 p.m. social hour, dinner at 7:00 p.m. with program to follow. Dick Greenberg, Executive Director of PEDCO will address the meeting on "Ways & Means of Attracting New Business to the Area." For reservations and further information contact Mark White at 545-5660.

**Ute Chapter**

October - For further information contact Bryant Rose at 242-5202.

## PES

Pueblo Engineers of Colorado.

Monthly meeting, October 10th. Cocktails at 6:30, dinner at 7:00. For information, contact Bob Erickson at 544-2791.

## PLSC

Professional Land  
Surveyors of Colorado.

Joint meeting with ACSM on October 6th. To be held from 9 a.m.-3:30 p.m. For information, contact Robert Chichester at 756-3695.

## RMAG

Rocky Mountain Association  
of Geologists.

For more information, contact Lorna Porter at 526-0613.

## SAME

Society of American Military Engineers.  
Dinner meeting, October 24th. Cocktails at 6:00, dinner at 7:00, and program at 8:00. To be held at Lowry AFB - Airman's Club. The speaker will be Col. Phil Weinert - U.S. Army (Retired). His topic will be "Central America and the Problems in Central America." For more information, contact Dave Sprengle at 751-0741.

## SSS

System Safety Society.

For information, contact Rich Tower at 977-9292.

## SWE

Society of Women Engineers.

October - For information contact Pam Tarquin at 333-4504.

## WIM

Women In Mining.

Monthly dinner meeting, October 10th. Cocktails at 5:30, dinner at 6:00, and program at 6:30 p.m. The speaker will be Susan Landon, a geologist with Amoco. Her topic will be "Oil and Gas Exploration in a Frontier Province: the Montana Thrust Belt." For more information, call Martha at 844-4481.

## CONFERENCES & WORKSHOPS

### CONFERENCES

INTERNATIONAL TELE/CON-  
FERENCING SYMPOSIUM (ITS)  
CONFERENCE

Hilton Hotel - Boulder, Colorado  
November 8-9, 1984

The fourth annual ITS '84 conference will focus on tele/conferencing success stories and address new tele/conferencing technologies, including trends in audio, computer-assisted, audio/graphic, and video tele/conferencing.

Sessions will include:

- Successful tele/conference design
- 'Winning' through tele/conferencing
- Merging and emerging technologies
- 'War stories' in tele/conferencing
- Future successes in tele/conferencing

ATTEND VIA TELE/CONFERENCE: IBIS and ITS will be available via slow-scan video tele/conference from the **Colorado Video** - Washington, D.C. facility and by audio tele/conference from anywhere in the world via the Confer Tech audio bridging system.

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## COLORADO SOCIETY OF ENGINEERS

Lunch Meeting  
October 2, 1984

Landmark Inn 455 South Colorado Boulevard

Cocktails 11:30 Lunch 12:00 Program 12:30

Speaker: John Simmance, Vibra-Tech

Topic: Ground Motion in the Courts

Cost: Regular members \$9.50

Junior Members \$6.00

For reservations call the CSE office, 426-5228, by October 1.



## CONFERENCES & WORKSHOPS

### CONFERENCES

#### Colorado Transportation Conference

DATES: October 23 & 24, 1984

TIME: Tuesday 8:30 a.m.-5 p.m.

Wednesday 8:30 a.m.-noon

LOCATION: St. Cajetan's Hall, 9th & Lawrence in Denver in the Auraria Higher Education Center campus

THEME: Technical and non-technical sessions under the theme "From Technology to Practice," the application of improved transportation technology. Cosponsored by University of Colorado at Denver and Colorado Department of Highways. Professor Roderick L. Down- ing award luncheon Tuesday, on cam-

pus, also 5:15 p.m. reception at Execu- tive Tower Inn (1405 Curtis St.)

REGISTRATION: \$18 prior to October 16, includes luncheon. Tentative agenda available late September. Con- tact Carl Sorrentino, 757-9228 BEFORE OCTOBER 16 for additional information.

#### 88th National Mining Conference & Exhibition

Denver Fairmont Hotel, Denver, CO — Sponsored by The Colorado Mining Association, 1515 Cleveland Place, Suite 410, Denver, CO 80202 (303) 534-1181.

### WORKSHOPS

The following courses will be taught on the campus of the Colorado School of Mines.

#### Heavy Oil Processing

October 25, 26, 1984

Instructor: Dr. James H. Gary, CPR Dept., CSM

Fee: \$375

#### Mining Economics and Feasibility Analysis

October 29-31, 1984

INSTRUCTORS:

Dr. Charles Berry, Mineral Economics Dept., CSM

David Wilson, Wilson Engineering FEE: \$375

For further information please contact the Office of Special Programs and Con- tinuing Education (SPACE), Colorado School of Mines, Golden, Colorado 80401, telephone 273-3321.

## ELECTRICITY IN COLORADO

### Continued from page 9

serious consequences.

It had been observed that the snow slide will tend to slow around a round object like a wood pole if it is strong and there is not too much debris. A wood- pole H-frame structure was designed and built, consisting of a double pole H-frame, in line with the flow of the snow, and X-braced between poles and braced uphill and downhill with poles and a steel angle on the uphill side of the uphill brace pole.

#### Boulder Hydro Project

Central Colorado Power Company was formed in 1906 and construction of the Boulder Hydro project was started on a plant in Middle Boulder Creek Canyon, about four miles west of Boulder. The project included Barker Dam, about 12 miles upstream of the plant on Middle Boulder Creek; Gravity Line, 11.7 miles, Kessler Reservoir, and a penstock, 1,828 feet head.

The depression of 1907 interfered with completion of the project and con- struction was resumed in 1909. Barker Dam was built on good rock below a large meadow, which was the site of the reservoir. Figure 12 shows the dam which is in Middle Boulder Creek, the lake, the spillway, and the Continental Divide, about 20 miles away. The outlet from the dam is near the bottom of the dam on the left side and the gates or valves are on the upstream face.

Figure 13 shows the dam under con- struction using cyclopean concrete. It is at an altitude of 8,180 feet. The crest is 720 feet long and 175 feet high. It was

completed in 1910 and took only 8 months to complete.

Some deterioration of the upstream concrete face took place due to sea- sonal changing of water level and high winds exposing the concrete to repeated freezing and thawing of the water, which caused severe deteriora- tion over some 36 years. A number of methods of repair were studied and an interesting plan was adopted.

It was felt certain that a thin cover would not be satisfactory. Thus a design included cleaning the old concrete face

and making slabs six feet by 12 feet of reinforced, air entrained concrete for the new face which would be resistant to freezing. These slabs were erected in front of the dam to act as forms for a fill of coarse aggregate and then grout was pumped into the aggregate from bottom to top in a continuous operation forming a part of the structure. The slabs were attached to the dam by steel dowels. This process was called "Prepakt". This blanket of concrete varied from three feet at the top to about eight feet at the bottom and added weight to the upstream side of the dam.

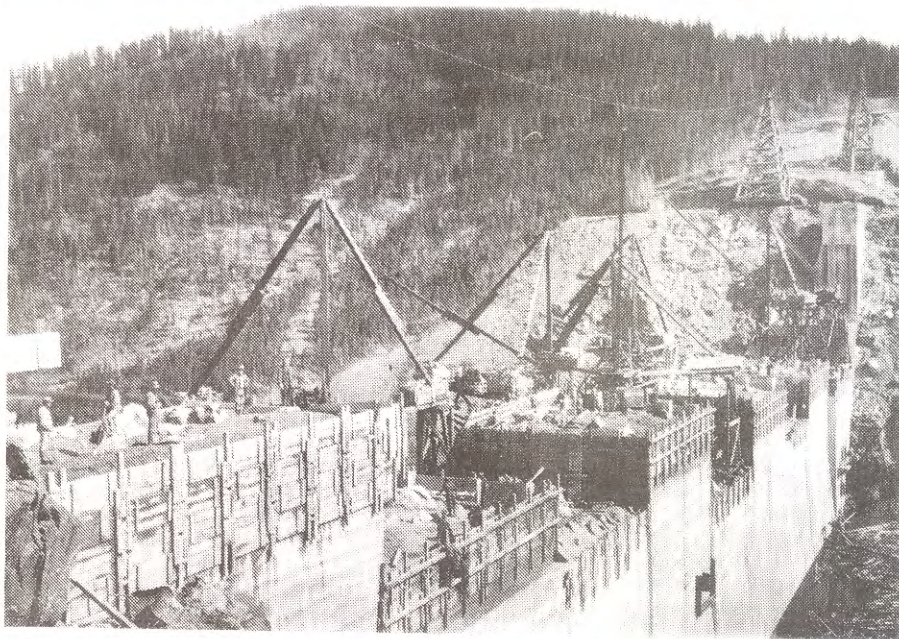


Figure 13. Barker Dam under construction using cyclopean concrete of gravity design. It was begun in 1906 and suspended in 1909. Completed in 1910, total construction time was 18 months.



The rock foundation of the old and new parts were grouted and drainage was provided. Outlet gates were replaced and the outlet structure was rebuilt.

This has been a very successful project. After more than 30 years, the new

peen hammer while the weld was still warm prevented cracking and solved the leakage problem.

The Boulder Canyon Plant, Figure 14, has two generators and two impulse water wheels with a head of 1,828 feet, which was the highest head in the United States at the time it was built. Figure

15 shows a 10-horse team pulling a wagon with one-half of a generator stator four miles from Boulder to the job.

The project went into service on April 4, 1910, with 10,000 k.w. capacity (it now is 20,000 k.w.) as a peaking and emergency, quick pick-up plant. The plant was connected to the Denver substation by a 90 k.v. line which ran 27 miles to Denver substation, and in 1924 with an eight-mile 90 k.v. line to the new Valmont plant.

A 44 k.v. line was built from the plant to provide power for construction of a tunnel through the Continental Divide under Corona Pass for the Moffat Railroad and for transporting water from the west to the east. This line is a single pole construction with insulators in a triangular position, two on a wood cross-arm and one at the top of the pole.

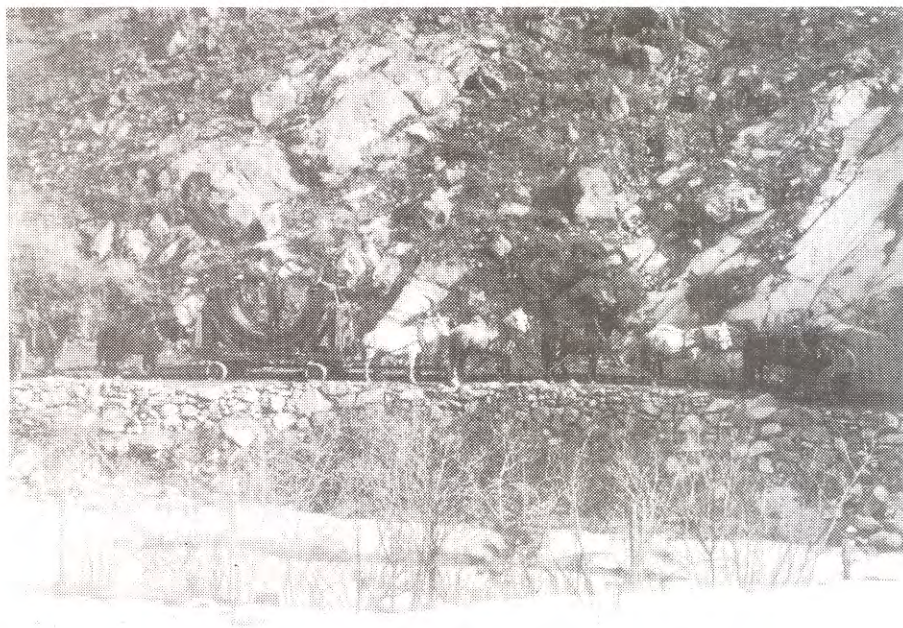
The line tripped out one winter night and could not be put in service because of a short circuit. A line crew patrolled the line on snowshoes and found snow depth near the top of the divide at about 12,000 feet in altitude to be up to the cross arm in depth. Further up in elevation, the snow was above the conductors which were passing through the snow in small tunnels that the heat of the conductors had formed. They found the body of a man who had walked into the conductors and had fallen across them.



**Figure 14. Boulder Canyon Hydroelectric Plant, constructed in 1906. Construction was suspended in 1907 due to a depression, but was completed in 1910. The capacity was 10,000 k.w. in two machines. It was rebuilt to a 20,000 k.w. capacity. The original indoor transformer was replaced with two outdoor units in a new substation on the left. A 44 k.v. substation was added to the right and off the photo.**

face is still in very good condition. A 36-inch gravity line, 11.7 miles long, was built from the dam to a forebay, Kessler Reservoir, 1,827 feet above the Boulder Hydro Plant. This was a difficult job. It involved clearing timber, building four tunnels in the rock and building seven siphons at canyons. A steel riveted pipe, or Penstock was built from Kessler, which is a daily storage reservoir, to the plant. Because of the very high head of water, or a pressure at the plant of 808 lbs. per square inch, the pipe was double buttstrap (one inside and one outside) of riveted steel design.

When water was admitted into the penstock, it leaked excessively at the riveted joints. A new method of welding steel by acetelyne had just been developed. Experiments were made on this type of joint and found that when the metal cooled in the joint it became brittle, but additional experiments showed that hammering the weld with a ball-



**Figure 15. A 10-horse team pulls one-half of a generator starter five miles up a mountain road in Boulder Canyon during construction in 1909. The horses in the rear are relief.**



# TEN BAD REASONS TO AVOID A MICROCOMPUTER

Reprinted from *FRONT•LINE*,  
August 1984,  
Westinghouse Industries Marketing

## 1. I might break it.

Yes, you might, if you take a sledgehammer to it. Day-to-day use doesn't break a computer, however, any more than it breaks a telephone or a typewriter. Sure a computer needs servicing once in a while, but so does your car—that computerized machine that's designed to withstand a slow-speed crash with a brick wall.

Even if you do break the computer, it's covered by a service contract.

## 2. I can't type very fast.

Ignoring the fact that a desktop computer can actually teach you to type, will you admit to typing at least as well as the four-year-olds now using computers? So much for that excuse.

While touch typing skills will help you make better use of some computer functions, others are as easy as using a calculator-type number keypad or even touching the screen. In any event, you'll be able to correct your typing mistakes easier than on a regular typewriter.

## 3. I'm no math whiz

Actually, that's a good reason to use a computer; let it do calculations for you. While computers a decade ago demanded mathematically minded operators, today those math whizzes can program—direct—your computer to work with you in plain English.

## 4. I want to work with humans, not machines.

A computer doesn't automatically cut you off from other people. In fact, since a computer's main attribute is its ability to do things very fast, it may save you time for other things—including working with people. Besides, a computer isn't a substitute for a person. It's a tool, like a wrench or a station wagon or a telephone switchboard. It's up to you to use a computer for effective organization instead of obsessive regimentation.

## 5. I'd rather avoid the health hazards computers cause to eyes.

The experts tested and tested again and found no basis for that claim. The National Research Council found no evidence that simply gazing at a computer terminal will cause excessive eye strain or disease like cataracts. That doesn't necessarily mean your eyes won't get tired after hours of viewing

computer-generated characters on a display terminal. The reasons for strain are being recognized and reduced by specialists called ergonomists. They design ways to reduce glare, control brightness, and adjust angles of machinery and chairs.

## 6. I don't want to have to learn a new language.

Which new language concerns you—the jargon computerists use or programming languages like BASIC, Pascal, or Fortran? In either case, you have no cause for worry. Programming languages are for programmers, the people that “teach” computers what to do. You don't have to know them to operate a computer. As for the jargon, don't let this verbal shorthand intimidate you. For one thing, most people who use it probably learned it only a month or two ago; this microcomputer phenomenon is still quite new. So next time someone lays a term on you like RAM buffer or pixel, turn the tables. Ask that person to explain in common words just what he means by that piece of computer jargon. You'll feel a surge of confidence hearing the so-called computer expert fumble for words.

## 7. I think I'll wait until computers are “user friendly.”

See, you're already using computer jargon yourself. Realize, however, that today's computers are not unfriendly, but simply that computer companies are striving for even more ease of use as they seek new customers. Computers are past the era of needing endless codes and numbers. Today's microcomputers use the same words we do.

## 8. I don't have time to sift through all the printouts computers give.

It's true computers can generate more information than we'd ever want. We've all seen the piles of green and white computer paper that data processors generate. But the advantage of using a computer yourself is letting the machine do the sifting for you. You can tell it what's important to you, and it will search its vast memory to provide exactly what you need—in seconds. The predicted Information Age brings an overload of information, which in turn creates the need for more efficient handling. Doesn't that sound like the perfect job for a computer?

## 9. I can't trust it with the important things.

Yes, it's disconcerting to see your hard work vanish from the computer screen. But it isn't gone, of course. The computer has filed it in its highly efficient system. You can always make a paper copy, hold it and touch it, then file it in your filing cabinet. It won't take long for you to recognize that it's easier and quicker to retrieve a document from the computer than from the file cabinet—and less likely to be lost or misplaced than in its paper form.

## 10. I don't want to look dumb.

We all know that so-called computer errors are really people errors, because computers only do what people tell them to do. Your fear is that if you tell a computer to do something incorrectly, people will question your competence. Actually, since microcomputers are so new, only a small percentage of all workers use or understand them.

Who's going to know if the computer screen flashes ERROR at you? Simply check the manual, fix your mistake, and go on. For every one person who might know enough to question your competence, you'll probably find a dozen others who are quite impressed with your new-found skill and will turn to you for advice in the computer age.

The point is, anyone can learn to use a computer; it's not that difficult. Read a computer magazine or book. Watch a demonstration at a nearby computer store or take a class. Ask questions of coworkers who use computers. Then get your hands on one—even if you have to borrow it. With only a day or two of practice, you can make a desktop computer do marvelous things.

## The eleventh reason.

There's an eleventh reason to avoid computers. Of all the reasons people give for not using microcomputers, this is the most prevalent. *I don't know what to do with a computer.* It's not a bad excuse; it's a good one. Until you know how a computer can help you do your job, you have no reason to use one.

Obviously, a lot of people have overcome this excuse, and many of the people getting desktop computers are just like you—working people who don't know much about computers. In fact, 50 percent of all retail sales of microcomputers are to Fortune 500 companies.

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## A QUESTION OF ACCOUNTABILITY

*The following is reprinted with permission from JOURNAL WATER POLLUTION CONTROL FEDERATION, March 1983.*

*When a newly constructed wastewater treatment facility does not operate correctly, it is not uncommon for the involved parties to point the finger of blame at each other. This lack of accountability sometimes needs to be resolved in court, but more often, the party at fault cannot be identified, and the federal and state governments and grantees end up paying to fix a treatment plant that they have already paid for. An amendment to the Clean Water Act has fostered a national effort to ensure better accountability in the construction grants program, and some of the aspects of this effort are examined here.*

By its nature, a wastewater treatment facility is a complex system of structural, mechanical, and electrical parts, and its ability to operate correctly depends, to a certain degree, on the quality of these components. More importantly, the success or failure of a treatment plant is often weighed by the expertise of the individuals who bring all those parts together and make them function as they were intended.

Those having the knowledge to plan, design, construct, operate, and maintain a treatment facility have a right to be proud of their abilities, and their pride is reflected by the numerous success stories of their accomplishments in the professional journals. On the other hand, when the treatment plant does not work, not only are these experiences rarely documented in the journals, but experience has shown that the responsible party is less likely to admit the blame for the problem.

### Too many cooks in the kitchen

Assuming that all the thousands of inanimate components of a treatment facility always will operate flawlessly is ridiculous. Nevertheless, it is not unreasonable to expect the professionals involved in the design, construction, and operation of a treatment facility to realize and accept their limitations to the degree that these limits can be minimized, and to stand behind the quality

of their products with reasonable assurances.

Yet, as any good chef knows, too many cooks in the kitchen can ruin even the simplest dish — and the situation is similar with treatment plant design and construction. In fact, in a June 1981 article in *Public Works*, author Ronald L. Bond compared the interactions of the involved parties in a construction grant project to a daytime television soap opera. In the scenario for his melodrama, Bond depicted his characters as follows: the Hero (grantee's treatment agency), the Wise Counselor (consulting engineer), the Rich Uncle (Environmental Protection Agency), the Brother-in-Law (Army Corps of Engineers), the Mother-in-Law (state regulatory agency), and the Bride (construction contractor). In Bond's story line the happy marriage (mutual accommodation) rapidly deteriorates once the honeymoon is over.

Seriously though, Bond had learned from first-hand experience that it is an awesome task to get all the involved parties to work together, and he pinpointed some of the reasons:

- The complexity of projects creates more opportunities for mistakes by contractors and design engineers.
- Contractors are pressured by inflation, dwindling profits, and government requirements.
- Owners and engineers are not accustomed to the risk allocation provisions of EPA contract clauses.

- Arbitration clauses in construction contracts allow contractors to press more claims.

- There is too much reliance by owners and engineers on boiler plate and exculpatory clauses in specifications.

- Engineers are reluctant to admit mistakes, possibly from fear of liability.

- More parties must be satisfied — EPA, the state regulatory agency, and the Corps of Engineers, in addition to the owner, the engineer, and the contractor.

### Extent of the problem

Estimates vary, but when Congress decided to examine the noncompliance problems of the nation's treatment plants, it had its General Accounting Office (GAO) investigate. GAO published a report in November 1980 (see February 1981 "Monitor") asserting that 50 to 75% of a sample of 242 treatment plants were at times in violation of their discharge permits. GAO further noted that the problems experienced by these treatment plants generally were caused by design deficiencies, equipment deficiencies, infiltration/inflow overloads, industrial waste overloads, and operation and maintenance deficiencies.

Although the validity of some GAO claims has been questioned, there was little argument that a widespread phenomenon in the five problem areas was the inability to ascertain who was responsible for the problem and who would correct it. The "bottom line," as GAO termed it, was that federal and state governments spend millions of dollars to fix treatment plants they originally paid to have built.

GAO observed that the laws and regulations clearly indicate that the grantee has overall responsibility for the proper design, construction, and operation of its treatment plant; yet the investigators found that many grantees had neither the expertise nor the technical staff to deal with the overall management of the construction grant project. For that rea-

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son, many grantees relied on EPA and the state reviewers to ensure that a treatment plant design would work. EPA and the state regulatory agencies, however, stating that their reviews were mainly administrative, made no attempt to evaluate the electrical and mechanical aspects or material quality of a project.

GAO recommended that EPA provide better technical and legal assistance to grantees to enforce contract requirements, as specified in Section 203(e) of the Clean Water Act. More importantly, GAO stressed the need for establishing clear lines of accountability on a construction grant project.

The investigators consequently recommended using a "turnkey" approach, whereby one part — preferably the architect or engineering design firm — be held legally responsible under contract for all development and construction aspects of a treatment plant. Furthermore, before turning the plant over to the municipality, the engineer would be required to demonstrate that the facility will operate properly and be capable of meeting discharge permit limits.

## Assessing responsibility

Since the publication of the GAO report in 1980, there have been significant changes in the construction grants program to determine who is responsible when a treatment plant does not work. A September 1982 EPA task force report on the program clearly identified the grantee as having overall responsibility and recommended that:

- The agency should increase awareness of cost-disallowance actions, suspension and debarment actions, and grant termination and annulment procedures.

- The agency should use Section 203(e) of the Clean Water Act to provide technical and legal assistance to grantees in pursuing legal remedies against engineers, construction contractors, equipment suppliers, and other contractors who perform defective work on construction grant projects.

In this vein, EPA has been updating its regulations and guidance to reflect the need for accountability. For example, the agency issued on September 16,

1982, regulations under which any person, firm, institution, or government entity can be debarred or suspended from direct or indirect EPA assistance for serious or compelling reasons, including poor performance, violation of contract provisions, noncompliance, involvement in fraudulent or corrupt practices related to an EPA-funded program, or conviction for civil or criminal charges.

Additionally, EPA's construction grants regulations and procedural guidance document, entitled *Construction Grants 1982* (CG-82), specifically clarify accountability (See Table 1).

However, the most controversial move toward accountability, which preceded many of the EPA revisions, was made by Congress in its 1981 amendments to the Clean Water Act when it approved Section 204(d) — known as the project performance amendment.

## Congress emphasizes performance

The idea to have a grantee's consulting engineer remain on site after start-up of the treatment plant has had limited application prior to GAO's recommending the practice. Several engineering firms have provided such a performance agreement with their grantee clients.

Based on GAO's findings and other testimony, the Senate Environment and Public Works Committee recognized the need to have some mechanism whereby grantees would have the opportunity to operate their new plants under a variety of conditions. The committee saw the design engineer as the natural choice in most cases as the party that would be most knowledgeable of a treatment facility project. The subsequent Senate amendment, S 1274, recommended that the design engineer warrant the proper performance on the facility that he designed.

The American Consulting Engineers Council (ACEC) testified against the warranty proposal, stating that an engineer cannot warrant the performance of a treatment facility. Rather, ACEC recommended that a project performance period, whereby the engineer would oversee operations for a specified length of time, would be a better way to proceed.

Under the final Senate-proposed amendment (to which the House of Representatives agreed), a construction grant would provide that the engineer or engineering firm supervising construction or furnishing architect/engineering services during construction continue its relationship with the grantee for a period of 1 year after completion of construction and initial operation of the treatment facility. During that period the engineer must:

- Supervise operation of the treatment facility,
- Train the operating personnel, and
- Prepare curricula and training materials for operating personnel.

The costs associated with the engineer's efforts will be grant eligible.

Section 204(d)(2) of the amendments states that 1 year after initial operation of the treatment plant, the owner and operator shall certify to the EPA administrator whether or not the treatment plant meets the design specifications and effluent limitations contained in its discharge permit. If the owner and operator cannot certify that the plant meets such specifications and limitations, then they must correct their problems in a timely manner, at other than federal expense.

The final provision, 204(d)(3), points out that nothing in the subsection on performance should be construed as prohibiting a grantee from requiring from any party even *more* assurances, guarantees, or indemnities, or other contractual provisions pertaining to a project.

Even though the responsibility for certification still rests on the grantee, the Clean Water Act provision clearly expects more of the engineer or construction management firm selected by the grantee, and suggests that the contracts between the grantee and each of the parties involved in the project include assurances, guarantees, indemnities, and other requirements regarding performance.

The design engineering community is clearly concerned about possible ramifications from this amendment and the liability it may have to assume. Yet some engineers point out that the amendment still indicates that it is the grantee who must certify that the treatment facility is operating as designed.



Table 1—Grantee and contractor responsibilities.

Responsible party	Municipality	A/E Firm	Construction contractor	Equipment supplier
Functions	Manage project Procure services	Design project Prepare drawings and specifications	Build facility Install equipment	Fabricate and deliver equipment
Responsibility	Operate facility Certify compliance	Process compatibility Meet design standards	Performance Reliability	Performance Reliability
Needs	Obtain A/E assistance Obtain legal assistance Obtain construction management	Insurance for error and omissions	Guarantees and bonds for equipment and performance	Warranties for bonds for equipment and performance

Whether the prospect of the grantee's wishing to obtain other assurances from the engineer will change this relationship is open to speculation at this time, because the requirement applies only to those projects receiving Step 3 approval after December 29, 1981. At this time, no projects have reached the point where the engineer would oversee the initial operation phase.

It should be noted that the project performance requirement applies to treatment and conveyance facilities, but the "level of engineering services" for interceptor sewers or sewer rehabilitation will be proportionately less than for treatment plants.

In response to the new amendment, EPA construction grants regulations similarly were modified. Part of the agency's guidance in *Construction Grants 1982* advised that in obtaining further subagreements from those under contract, the grantee should examine the timing of coverage for insurance, warranties, and bonds relating to the initiation of operation. Moreover, the guidance recommended that if the owner could not certify performance, it must provide to EPA an analysis of the problem, estimate the nature and scope of the problem and the requisite costs to mitigate it, and develop a schedule for compliance.

### Points to ponder

No one involved with the construction grants program expects the new provi-

sion to be a cure-all, but there are indications that it will bring about certain benefits. Apart from the obvious fact that more properly operating treatment plants will come on line toward the betterment of water quality, the emphasis on accountability will help weed out those parties from construction grants who cannot back up the quality of their work. Furthermore, because the engineering services for the 1-year period are grant eligible, apparently this has provided the incentive for some engineering firms either to develop operations expertise or to associate themselves with firms specializing in operations.

There are some adverse effects that may result from the provision. For instance, one congressional staff member expressed concern that an engineer's attitude might be: "If anything goes wrong, we can always fix it later."

The engineering community remains cautious about what may happen when the performance periods of construction grant projects commence. As ACEC testified before the Senate Environment Committee in 1981, the engineer does not have control over certain segments of EPA-funded projects, whereas under a privately funded project he would have more control.

Testifying on behalf of ACEC, Malcolm Pirnie President John H. Foster related several factors in a construction

grant project over which the engineer would not have control:

- Requirements that engineer selection procedures change engineers between planning and design, or between design and construction phases.
- Requirements for the engineer to change plans and specifications following review by state regulatory agencies or EPA, and as a result of bidability and constructability reviews by the Army Corps of Engineers.
- Required delegation of part of the design and construction to subcontractors with limited experience under the Minority Business Enterprise/Women's Business Enterprise rules.
- Possibility of selection of a different engineer to prepare operation and maintenance manuals.
- Need for segmenting construction because of funding limitations, with the necessity to place plants in operation before all facilities are completed.
- Subsequent addition of major new industrial or commercial users after establishment of original design loading.
- Improperly trained or inadequately paid or qualified operating staff working in the treatment facility.
- Elimination or substitution of equipment or treatment units if con-

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# ACCOUNTABILITY

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struction bids exceed available funds.

● Wastewater loads mixed with materials toxic or damaging to treatment processes or units.

The question of professional liability is one of critical concern to the engineering community. Professional liability insurance policies carried by consulting engineers contain specific exclusions so that warranties, guarantees, or assurances made by the engineer are not covered by insurance. And according to a recent ACEC professional liability survey, insurance costs for engineers are rising, as are the number of claims against them. Fully 65% (up 5% since 1981) of engineering firms surveyed in 1982 had liability coverage of at least \$500,000. Regarding claims, the average frequency in 1982 was one every 2.9 years; for firms over 500 employees, the frequency was one claim every 2.4 months (versus every 4 months in 1981).

Foster argued that the increased liability of the engineers and the risk of having no insurance coverage would place the engineers in a defensive position where they would fight any claims. Such circumstances in turn would keep the courts busy, yet do nothing to improve poor plant performance in the interim.

## Everybody is accountable

Discussions with groups involved in the construction grants program indicate that the project performance provision likely will result in more specific contracts being written between the grantee and its engineer, contractor, and equipment suppliers; and possibly subagreements between the engineer, contractor, and equipment suppliers as well. This accountability-forcing activity may indeed be more complicated, but it

probably will establish, once and for all, who is responsible for what — and it should lead to better constructed treatment plants that will perform as well as they were designed.

The accountability movement may well improve the quality of the work performed by the grantee's engineers, contractors, and equipment suppliers. As a congressional staffer said, "After all, all

of the involved parties under contract to the grantee are professionals who get paid for their expertise. Taxpayers shouldn't have to keep paying for their mistakes if the professionals do the job right in the first place. And once we get the plants built correctly and working right, we'll be further along the road to cleaner water."

D. V. Feliciano

# COMPUTERS

Continued from page 18

And 40 percent of all retail sales of microcomputers buyers are new to computing. They've learned what to do with computers.

## Computers for field management.

Approximately 120 members of Westinghouse field management are learning what to do with computers. They recently attended a new training module entitled "Introduction to Personal Computing." Sixteen day-and-a-half-long modules were attended by region and district managers from construction, electric utility, and industrial field sales and by marketing Support Division management. Presentation of the training module followed installation of 26 IBM Model XT PCs in 24 district offices.

According to Dave Drenning, Manager, Advanced Marketing Systems, "What we are aiming for in this pilot program is to provide selected managers with a basic understanding of what the personal computer can do. Then they will say to themselves, 'How am I going to use this new tool to make my job easier and more productive — to sell smarter and better?'"

One use currently being developed by construction field sales is a negotiation tracking system. The PCs will be used in

the industrial area to adapt the Industry Electronics Division's internal pricing program for field sales use in negotiation support. Another possible application is computation of alternative bid pricing.

From data processing, to word processing, to marketing, finance, shipping, graphics, and field sales, desktop computers are spreading through Westinghouse. They're here to help you, so "log on" and join in.

# MONDAY

Continued from page 13

the sweet rolls. That sugar boost will quickly give way to mid-morning letdown.

● Avoid irritation when you're vulnerable. Leave a bit earlier for work to miss the worst of rush hour. Steer clear of aggravating people.

● Plan something enjoyable for Monday — maybe lunch with a friend. This will give you something to look forward to.

● Endure. Keep in mind that the Monday blues will pass. Don't try to make big decisions while you're feeling down. Just ride it out until your spirits pick up. Remember, tomorrow's Tuesday.

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