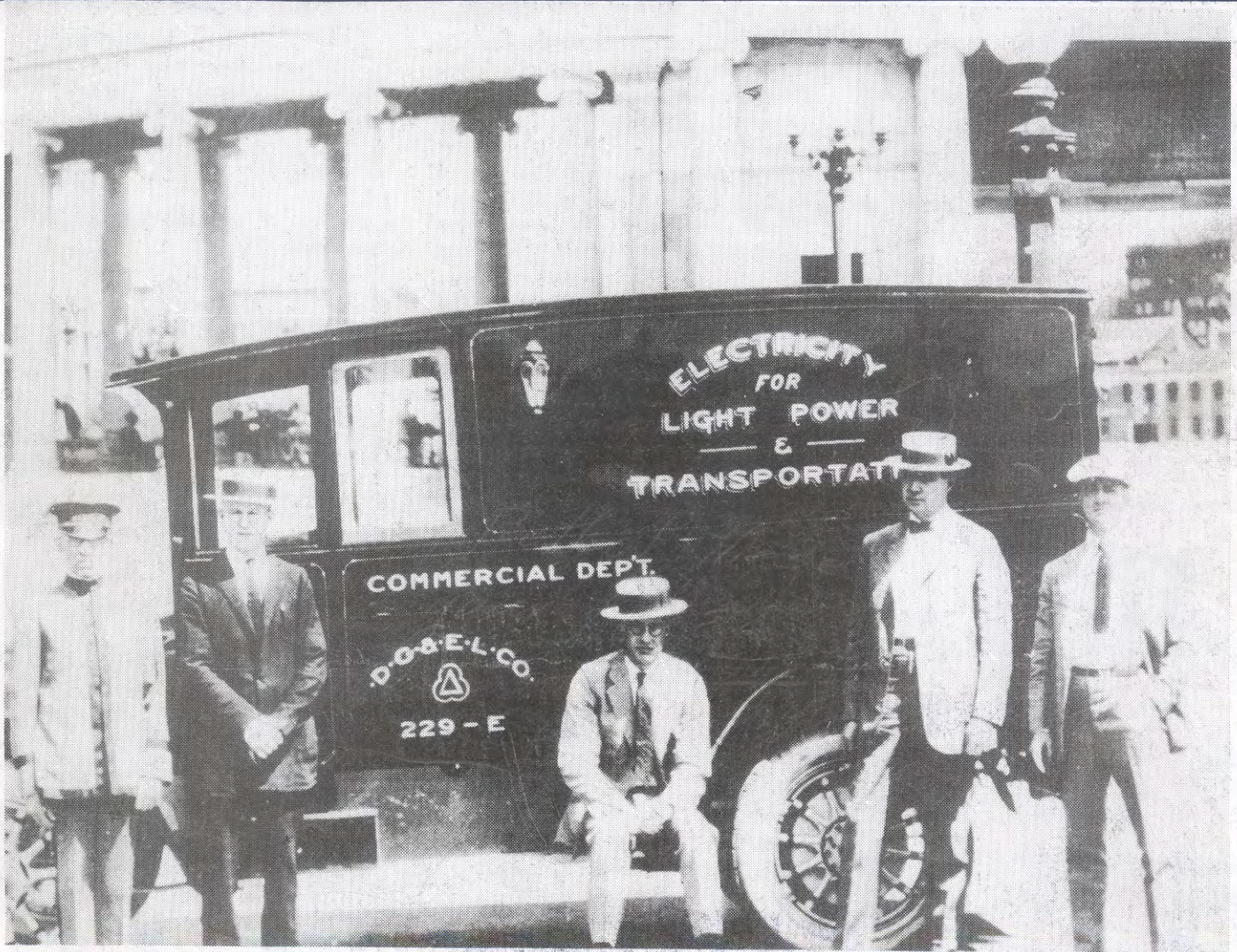


western engineer

Volume 68, Number 9

SEPTEMBER 1984



THE BIRTH AND GROWTH OF ELECTRICITY IN COLORADO — PART 1 See Page 10.

1884 1984
A CENTURY OF ELECTRICAL PROGRESS



THE INSTITUTE OF
ELECTRICAL AND
ELECTRONICS
ENGINEERS, INC.
Denver Section

RockIEEE
Overlook
See Page 10

PRESIDENT'S MESSAGE

James M. Dougan
President — Colorado Society of Engineers

As summer draws to a close, it's time to turn our attentions to the start of our 84 program. Most of our chairman's positions are filled, but we **still** need program project leaders. If you have a pet project, bring it to our September 4th all-members meeting, or contact our program chairman, John Boring. To those who have volunteered, Thank You!

Our golf tourney was held July 20th and hopefully again on August 13th. To Melissa Browning-Sletten, Walt Howat and John Kreiling, "A Hearty Good Job", twice over. Hope the weather

cooperates for the August 13th replay. To those of you who started out Bird, Bird, Eagle — a tear and our deepest sympathy.

Our first all-member meeting will be held on Tuesday, September 4th at the Landmark Inn. Cocktails at 6:30, dinner at 7:00 and program at 8:00. Our speaker will be Neil Kelley from the Solar Energy Research Institute. I hope you will plan to attend. Your needed feedback will determine what the Society accomplishes this year. Bring your wife, your girlfriend, your boss or just your own good cheer. But do be there.

WORKSHOPS & CONFERENCES

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

Processing of Energy Minerals: Coal, Shale, Tar Sands, Uranium

September 5-7, 1984

Instructor: Dr. Baki Yarar, Metallurgy Dept., CSM

Fee: \$395

The Management of Exploration

September 12-14, 1984

Instructor: Dr. Geoffrey Snow, Noranda Exploration

Fee: \$575

Mining Economics and Feasibility Analysis

October 29-31, 1984

Instructors: Dr. Charles Berry, Mineral Economics Dept. CSM
David Wilson, Wilson Engineering

Fee: \$375



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Submission of articles for publication in WESTERN ENGINEER is invited. All such materials must be received by the CSE office, 7000 Broadway, Suite 107, Denver, Colorado 80221, by the first of each month for the following month's issue.

CHAIRMAN'S MESSAGE

By John B. Richards, Chairman IEEE Denver Section

Thanks. That one word sums up my feelings about the outstanding work done by the many volunteers who make the Denver Section function. It is also extended to the people who take time out of their busy schedules to attend Section and Society meetings. All of the people who attend IEEE functions help to make us successful. In that same light, if you are not participating in IEEE activities for some particular reason, I'd very much like to know why. If you aren't, give me a call at 329-1177.

You're invited. All members are always welcome to come to all Executive Committee meetings. There are no 'closed' meetings. At these meetings we decide many things, not the least important of which is the budget. It is, in fact, probably the most important thing;

consuming more time than any other item. The Executive Committee will meet approximately every other month. The meetings are planned for the fourth Tuesday of the month. The first meeting this year will be September 25, 1984 at the Public Service Company office at 5900 East 39th Avenue in Denver. The scheduled time is always 7:30-9:30 PM.

CONGRATULATIONS. My personal congratulations to the IEEE Reliability Society. At their September 19th meeting, they will be presented an award as the Denver Section's Chapter of the Year. Their meeting will be at the Holiday Inn North, 4849 Bannock, 6:30 Cash Bar, 7:30 Dinner. Their speaker will be Mr. Chuck Rice. He will talk about Problem Solving. Please call Ms. Sandy Johnson at 938-2849 for information.

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Editor's Note: Uncle John is on vacation. His column will return in the October issue.

In Tribute...

JAMES B. SPEER — FRIEND AND ENGINEER

On June 28 in Limerick, Ireland an automobile accident claimed the life of Jim Speer, known by many in the Colorado Society of Engineers. A member of CSE since 1981, Jim was also a member of the Professional Engineers of Colorado and the society's Executive Director since 1980.

Jim's untimely passing occurred shortly after arriving in Ireland with his wife Rosemarie. They were on their annual pilgrimage to pursue studies at Worcester College in Oxford, England. Sharing a deep interest in English history, they each focused on specific studies, Jim on archaeology and Rosemarie on English literature and architecture.

Born May 1, 1923 in Texas, Jim graduated from Canyon High School, Canyon, Texas, in 1940. That year he began his undergraduate work at West Texas State University and was a teaching assistant in the Department of



JAMES B. SPEER

Chemistry. From 1943 to 1946, he did a tour of duty in the Army.

Building on his undergraduate degree in chemistry and math from West Texas State University, Jim added a masters degree in those studies in 1951 from Texas A&M University.

While there, he taught chemistry and wrote course material for petroleum and agricultural engineering curriculum.

He was recalled to active duty in the Army in 1950 and began a military career that spanned nearly two decades. Working from his background in chemistry and teaching, Jim was Supervisor of the Medical Laboratory and Pharmacy at the U.S. Army Hospital at Red River Arsenal, Texas. He became an instructor in non-military subjects after receiving the commission of Second Lieutenant in 1951. By May 1954, he had become Chief of the Chemical Branch of the U.S. Army Chemical School, providing instruction in chemical warfare, other areas of chemistry and chemical engineering.

In the following four years, Jim served as a nuclear weapons officer, technical operations officer and nuclear

Continued on page 6

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— Mr. Paul C. Daubitz - President - ATI Telemanagement

Intelligent buildings are little understood today. Soon they will be perceived as a dynamic new means of enhancing productivity as well as creating profitable new opportunities in telecommunications. The building complex will soon reach its full potential for the building developer, owner, and tenant. The CIC-IBIS Executive Report provides a critical outlook for this expanding industry.

— Mr. R. Craig Blackman - Editor & Publisher - *Comunicaciones*

Intelligent buildings provide the real estate developer the ability to gain control over telecommunications and new information services that were formerly the domain of the telephone company.

— Mr. Charles Nichols - E.F. Hutton

A new "megatrend" is emerging today. Information and telecommunications technology is being forged with new options for building management. The rapid growth of the "smart design" and the "intelligent building" will be the driving forces of building development in the 80s, 90s, and beyond. Intelligent buildings are those structures which include not only multi-tenant telecommunications but also information technology, teleconferencing, local building area networks, energy management, and other new information technologies as well as computer-controlled environmental support systems.

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If you are a building/facility ownership/management organization or a provider of information systems concerned with new revenue opportunities or just managing costs, you will benefit by this CIC Executive Report.



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934 PEARL, SUITE B BOULDER, COLORADO 80302 303/444 7799

In tribute...

Continued from page 4

supervisor at a national stockpile. As a chemical staff officer, he spent a year in Korea advising the U.S. Army commander and staff on offensive and defensive tactics in chemical and other warfare. He also inspected units and made recommendations for improvement of main battle positions along the DMZ.

In 1961 Jim received his undergraduate degree in nuclear engineering from the Naval Post Graduate School in Monterey, California. He spent the following nine years in various positions within the Chemical Corps, including Post Inspector at Denver's Rocky Mountain Arsenal from 1963 to 1967.

After his tenure at the arsenal, he spent a year in Vietnam with the 25th Infantry Division, serving as Assistant Operations and Training Officer and later as Development Officer for the First Logistical Command. Ill health forced Jim's retirement from the Army in 1969 as a Lieutenant-Colonel.

During his long career, he received numerous military decorations: the Bronze Star, Army Commendation Medal with Oak Leaf Cluster, Armed Forces Reserve Medal, Vietnam Service Medal with Silver Star, and the Vietnamese Cross of Gallantry with Palm.

Teaching continued to be the focus of Jim's professional efforts until his death. From 1970 to 1984 he held several academic positions, including instructor and Assistant Professor in Mathematics at Metropolitan State College, and instructor at the Community College of Denver. He taught a variety of mathematical disciplines in addition to quantitative chemical analysis. He also designed and taught math courses for engineering technicians.

Jim's interest in education led him to active involvement in the Friends of the Auraria Library Board where he served a term as its chairman. Equal opportunities for post and secondary education for all students was a major goal in his life.

Jim also served as Executive Secretary for the Colorado State Board of Registration for Professional Engineers and

Land Surveyors from August 1974 through February 1980. In his personal world, he was actively involved in the Republican Party, the American Legion and Veterans of Foreign Wars.

Jim is survived by Rosemarie, his wife of 37 years, and their two children, Rosemary Pool of Baltimore, Maryland, and Jim of Denver. Jim also has two sisters, Velta Reeves and Elvia Linnard, who reside in Texas.

At the suggestion of the family, those who wish may make a contribution in Jim's name to the Holy Cross Abbey, P.O. Box 351, Canon City, Colorado 81212.

EDITOR'S NOTE

Jim Speer was an active and dedicated participant in the publication of WESTERN ENGINEER until December 1981 when CSE and PEC ended joint publication efforts, resulting in two engineering magazines. He continually sought ways to reinstate a single publication as the voice of Colorado's engineers and to foster engineering unity. Maybe someday the seeds of unity he nurtured will bear fruit to the benefit of all.



Don't Overlook Overhead Lines

Overhead power lines are such a common sight that it's easy to overlook them. That's a mistake—sometimes a deadly mistake.

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- ELECTRICAL HARNESS DESIGN
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- COMMUNICATION SYSTEM DESIGN
- INSTRUMENTATION SYSTEM DESIGN
- ELECTRONIC PACKAGING AND PRINTED CIRCUIT DESIGN
- GUIDANCE AND NAVIGATION SYSTEM INTEGRATION
- ANALOG CIRCUIT DESIGN
- INSTALLATION AND LAYOUT DESIGN
- NUCLEAR HARDENING AND EMC ANALYSIS
- TELEMETRY AND RF SYSTEM DESIGN
- ELECTRICAL POWER SYSTEMS

FLIGHT SOFTWARE SYSTEMS

You will conduct analysis and trade studies required to define functional and performance requirements for space vehicle and cruise missile on-board flight software. Responsibilities include establishing time lines, functional flows, data flows, operational modes, sequences and requirements to flight program elements. You will also write functional/performance specifications, develop plans and conduct systems level verification and validation of flight software. Experience in one or more of the following areas is helpful.

- NAVIGATION/GUIDANCE ANALYSIS
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- S/W VERIFICATION & VALIDATION
- REAL-TIME SYSTEMS
- POWERED FLIGHT MECHANICS
- ORBITAL FLIGHT MECHANICS
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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

The birth and growth of electricity in Colorado is an interesting story of the people and their role in the development of the state and its resources.

This birth took place on April 21, 1880 when an exhibition arc light plant was installed in Denver and light was produced for the first time by electricity. This was only three years after Farmer and Brush of Cleveland introduced the arc lights on a commercial scale and Edison started the Pearl Street station and system in New York in 1882.

The electric industry was started in Colorado in 1887 with the "pioneer" hydrostation in Aspen which was built to supply power to the mines in the area. The second town in Colorado to use electric power was Leadville in 1883 with the introduction of arc lights.

Prior to this, the Denver Gas Company built a manufactured gas plant (Figure 1) for producing gas for lighting streets and homes. The company started laying pipe in 1870 when the first two railroads reached Denver, and supplies and equipment could be brought to Colorado.

All of this took place early in the history of Colorado as gold had been discovered in 1859. This discovery brought on the Pike's Peak gold rush of that same year. Two years later, Congress created the Colorado Territory and in 1876, the state of Colorado was admitted to the Union.

It might be well to briefly review the conditions in Colorado at the time of the advent of the two railroads from the Missouri River in 1870. This will help the understanding of the history of the electrical industry in Colorado.

The eastern half of the state was a vast expanse of prairies, and to the west were the high rugged mountains which were inhabited by hostile Indians. Only those articles necessary for bare existence could be hauled across the plains by horse- or ox-drawn wagons.

Steam was the only mechanical power that could be artificially produced at this time. It was practically impossible

THE EARLY YEARS 1880 to 1918

to transport the boilers, engines and equipment with wagon trains, thus leaving the pioneers to rely on hand tools. There was no power for saw mills, except for that which was provided by running streams. Small mills of various kinds could be driven by wooden paddle water wheels, utilizing the energy nature provided. No artificial lighting was available except candles, oil lamps or firebrands.

Telluride Power Company

Telluride was the site of one of the earliest and richest mining districts in Colorado. Even though it was located in the southwestern part of the state high

in the rugged San Juan mountains, some mines and mills used steam power with coal as fuel. However, this proved prohibitively expensive and caused several financial failures. One example of this kind of failure was the Gold King mill. This mill was located in the mountains at 12,000 feet, and was one of the first to use coal as an energy source. But in 1888, it was legally attached for deficits brought on by the high cost of power.

Less than three miles down a deep gorge near Telluride, two streams joined and formed an excellent natural source of power. Studies were made of cable drive, compressed air and "continuous current" electricity. A decision was made to use alternating current at "high pressure" voltage, much to the incredulity and promises of failure by some engineers.

The first generator and motor, 100h.p.



Figure 1. Gas manufacturing plant in Denver for the first street light in 1880. Removing coke after the coal was "baked" to produce combustible gas.

each, 3,000 volts, single phase, 133 cycles were installed. The generator was located in the new Ames plant and the motor was located at the Gold King mill. This was accomplished in 1890. It had been said by authorities that there was no alternating current motor, that oil insulators must be used, and that the line must be fenced in.

The generator was belted to a six-foot Pelton water wheel under a 320-foot head and connected through jaw switches and fuses and arc light plugs to a 3,000-volt line to the motor at the mill. The line had two No. 3 copper wires on Western Union cross-arms and insulators.

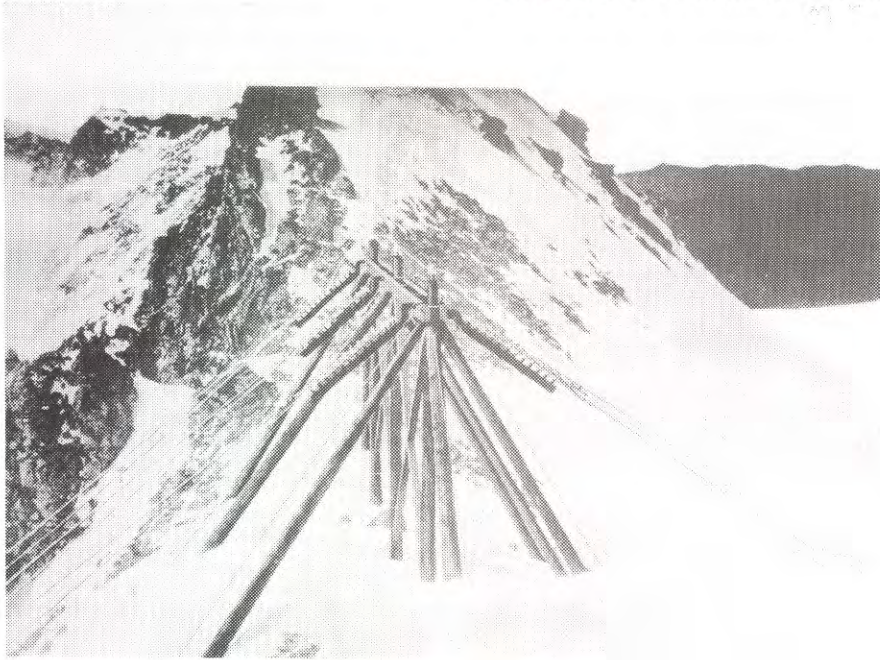


Figure 2. The tower on the summit of Camp Bird Divide, 10,000 volts, altitude 13,000 feet.

The main motor had a 3,000-volt single phase starting motor which had to be started by hand. There were severe lightning and winter storm problems at first until lightning arresters were developed. A 600 h.p. generator was installed later and additional load in the Savage Basin area was added in 1892.

Much invention and development took place including tests of two-to-three phase systems, insulation, transformers, and the Tesla system of two 600-kilowatt, 60-cycle 500-volt, two-phase to three-phase generators for a 10,000-volt transmission in 1896.

In 1895, tests were made for high voltage transmission by carrying the Gold King mill at voltages from 15,000 to 60,000 over a separate line and transformers.

One interesting operation involved the early wooden switchboards that carried 3,000 volts. There were no circuit breakers and if a motor dropped out of step, it was necessary to break the circuit with a single arc plug. This always drew a heavy, vicious arc which frequently held to the full length of the six-foot cable, and then sometimes the attendant would have to "whiff" the arc with his hat to break it. When not broken promptly, it frequently involved the entire switchboard and shut down the plant.

Figure 2 shows the method of dead-ending the line using cross-arms and pin insulators on the summit of Camp Bird

Divide at an altitude of 13,000 feet and span a length of 1,150 feet. Conductors are No. 1 copper supported by half-inch plow steel cables.

Later, the Ames plant reduced the power bill of the Gold King from \$2,500 per month to \$500 per month, saving the operation. The Telluride company expanded its territory with 44-kilovolt lines and added hydro and steam plants and became the Western Colorado Power Company. An interesting design of wood tank, 60 kilovolts, bottom-connected oil circuit breaker was installed in an early substation at Silverton, Figure 3.

Denver Area Developments

The Colorado Electric Company built the East Side Station in Denver in 1881

at 21st and Wewatta Streets. It included "Old Sally", a 250 h.p. Wright steam engine with two 35 h.p. Brush-Swan direct current, constant current generators for arc lights. This was the first electric machinery west of the Missouri River and third largest in the United States. The Daniels and Fisher store was the first to use electric light in 1881.

The Denver Gas Company had a contract with the city of Denver to supply street lights until 1885. The Electric Company wanted to demonstrate the superiority of arc lights for street lighting. Between 1881 and 1885, it built eight iron towers which were 150 to 210 feet high, with eight 3,000 candlepower arc lights on each tower. They were called "Lighthouses of the Plains". At this time, most residences were not wired for electricity but the Company could supply special lighting and had batteries, lamps and wiring for use on special occasions. The batteries were hauled to the location in horse-drawn wagons and located outside. They were picked up the next day for recharging.

The Electric Company obtained a franchise for street lighting in 1885 and replaced the gas lights with 20 candlepower bulbs on the old gas lamp posts and dismantled the towers in 1891.

The Electric Company built the West Side Station (Figure 4) at West Colfax and Rio Grande railroad tracks in 1887

Continued on page 16

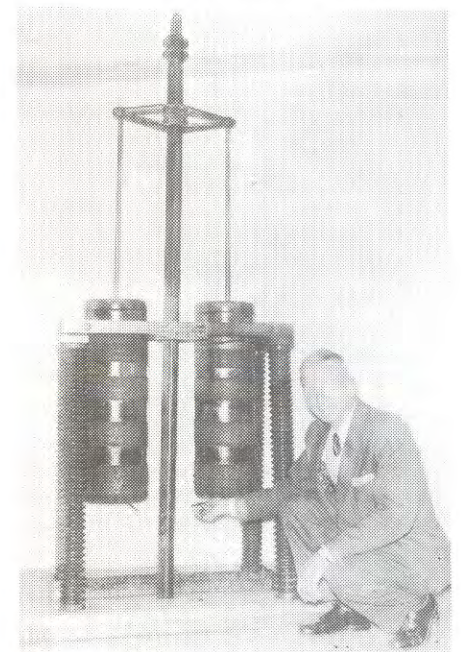


Figure 3. Wood tank, H-type oil circuit breakers form Silverton (44 k.v.) substation of Western Colorado Substation.



THE INSTITUTE OF
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ENGINEERS, INC.
Denver Section

RockIEEE Overlook

CHAPTER'S COLUMN

By Mike Foley, Group's Chairman, Denver Section

The summer is history and another chapter year is upon us. This new column will keep you informed on chapter activities of interest to the Section membership. Also look for a calendar noting the chapter meetings scheduled for the month. I hope this will assist you in planning your schedule so you may

attend one or more chapter meetings of interest each month.

Take a moment to find out who is your Chapter Chairman this year. All Chairmen are listed on the last page of the Overlook section.

If you don't belong to a chapter (technical society) or if the society of which

you are a member isn't on the list of Denver Section Chapters, give me a call (Mike Foley 329-1592).

Look for this column next month containing a profile of one of the chapters.

CHAPTER ANNOUNCEMENTS

IEEE DENVER SECTION JOINT MEETING/RELIABILITY SOCIETY

- DATE:** Third Wednesday in September — September 19, 1984
PLACE: Holiday Inn North, I-25 and 120th Exit East.
TIME: Social @ 6:30 pm; Dinner @ 7:00 pm; Meeting @ 7:30 pm.
PROGRAM: The first Denver Section meeting of the IEEE 1984-85 year will be hosted by the RELIABILITY Chapter, winners of the "1983 DENVER SECTION CHAPTER OF THE YEAR" Award. (see Reliability Chapter meeting announcement for program details.)
The Denver Section Chapter of the Year Award is presented annually to honor the Technical Chapter which in the previous calendar year exhibited the best overall program of Technical, Professional, and Social meetings, percent of membership in attendance, new member growth, and outreach to other societies and the community at large. A check for \$100 also accompanies this annual award. The Denver Section Chapter of the Year is inturn recommended for the Region 5 Chapter of the Year award which is also a tangible award.
- RSVP:** There will be a premeeting social and dinner with dinner reservations required no later than Friday noon September 7, 1984. Dinner is not required to attend the 7:30 pm meeting. For more information about the program and/or dinner reservations, call Craig Hartman @ 987-4256.

LITTLETON CHAPTER EMC

- WHEN:** September 18, 1984, 7:00 pm
WHERE: 393 Inverness Drive South, Englewood, Colorado
SPEAKERS: Steve Limn of the Federal Communications Commission and Chuck Hilger of Tektronics Corp. will discuss logic analyzers and will have several tektronics analyzer models for demonstration and hands-on use by meeting attendees.
For additional information about the meeting, please contact Bob Loveland at 977-6578.

IEEE RELIABILITY SOCIETY DENVER CHAPTER MEETINGS

SEPTEMBER MEETING

- TITLE:** IEEE Reliability Dinner Meeting
DATE: Wednesday, September 19, 1984
TIME: 6:30 PM cash bar, 7:00 dinner
PLACE: Holiday Inn North, 4849 Bannock, Denver
TOPIC: Problem Solving
SPEAKER: Chuck Rice, University of Colorado

NOVEMBER MEETING

- TITLE:** IEEE Reliability Technical Meeting
DATE: Thursday, November 15, 1984
TIME: 7:00 PM
PLACE: Suite 107, Colorado Society of Engineers, 7000 Broadway, Denver
TOPIC: Simulation/Modeling (Operating System Modeling)

**IEEE RELIABILITY SOCIETY
DENVER CHAPTER ANNOUNCEMENTS**

1984-85 OFFICERS

Chairman — Ron Watts
Vice Chairman — Mike Jinnette
Secretary — Juan Hernandez
Meeting Chairman — John Etter
Newsletter Chairman — Sandy Johnson
Charter Chairman — Sam Keene
Past Chairman — John Adams

There are openings for people interested in becoming more involved with the IEEE Reliability Society in the area of Membership Chairman and Finance Officer. Anyone interested should contact Ron Watts, 471-9110, ext 4151. Thank you.

CALL FOR PAPERS

The third annual Software Reliability Symposium will be held at Ford Aerospace in Colorado Springs in the April time frame. The Chapter would like to encourage national participation. Please send an outline of any proposed papers by the early February time frame. The outlines should be sent to: Ron Watts, Ford Aerospace, 10440 State Highway 83, Colorado Springs, Colorado 80908

Thank you for your help. Please call me if you have any questions.

Sandy Johnson, NBI, Inc.
303/938-2849

PES/IAS

PES/IAS Meeting Notice

DATE: September 20, 1984
TIME: 6:00 Social Hour (Optional)
6:30 Dinner (Optional - \$10)
7:30 Meeting
PLACE: Regency Hotel, 3900 Elati, (Room - "#10 Downing St.")
TOPIC: Interconnection of Small Power Producers to the Public Service Co. Electric System.
SPEAKER: Thomas J. Yohn - Professional Engineer in System Protection Engineering at Public Service Co. of Colorado. Mr. Yohn holds B.S. and M.S. Degrees in Electrical Engineering from the University of Colorado. He has been with Public Service Co. for 11 years, and has worked with small power producers for 5 years. Mr. Yohn is the primary electrical liaison working with the integration of small generation plants to the Public Service system. He is a Registered Professional Engineer in the state of Colorado, and a Senior Member of the IEEE.
RSVP: Darrel Sabatka, Public Service Co. of Colorado, 329-1547 by September 18, 1984.

PES/IAS Future Meeting Topics

Forensic Engineering
Tour of Gates' Facilities
Equipment Acceptance Tests
CAD Systems
Residential Energy Conservation
Construction Techniques
Examples of System Resonance
Co-Generation
Tour of Celestial Seasons
Cable TV
High Voltage DC Power Transmission
Electronics in Power & Industry
Uninterruptible Power Supplies
Management Seminar
Financial Planning for Engineers
Light Rail in Denver
Medicine Bow 4MW Wind Turbine

IEEE PROFESSIONAL ACTIVITIES MEETING

DATE: Fourth Monday in September — September 24, 1984
PLACE: Quality Inn Downtown, I-25 and Speer Exit West
TIME: Social @ 6:00 pm; Dinner @ 6:30 pm; Meeting @ 7:30 pm.
SPEAKERS: George Dean, USAB Government Activities Council Chairman. Elizabeth Taylor, Region 5 Government/Legislation Coordinator.
The USAB GAC currently has committees for: Technology Transfer; U.S. Technology Policy; Internal/External Communications; and the Congressional Fellows, and Legislative Newsletters. George has also personally supported IEEE National and Local Legislation for Precollege Math & Science Education. Elizabeth has been coordinating local legislation efforts in the 12 states comprising Region 5. Current subjects of interest to these local Government Legislative Committees are: Age Discrimination in Employment; Patent Law; Pensions & Benefits; Tax Credits/Incentives; Math & Science (Computer & Engineering) Education; High Technology Support; and other pertinent legislation effecting local IEEE members. Come hear about these IEEE Government/Legislation efforts and join in the discussions.
RSVP: The premeeting social and dinner will require reservations. Call Bill Whipkey @ 427-2411 before noon, Friday, September 21, 1984. Dinner is **not** required to attend the meeting @ 7:30 pm. All IEEE Members, Family and Friends of Engineering are Welcome.

Please remember to notify the Groups Chairman of your scheduled meeting (to minimize the conflicts), election of officers, and your bulk mailing needs (200 plus pieces). Also, all society meetings must be published in the "RockIEEE Overlook" to receive credit.

IEEE CANDIDATE FOR REGIONAL VICE CHAIRMAN, 1985-REGION 5

EDWARD C. BERTNOLLI, Director UMR Graduate engineering Center in St. Louis and Professor of Electrical Engineering University of Missouri-Rolla (Nominated by Region 5) (Election ballots mailed to members by 9/1/84)

Dr. Ed Bertnolli is Professor of Electrical Engineering and Director of the University of Missouri-Rolla Graduate Engineering Center in St. Louis. He works closely with St. Louis industry in administering Master of Science programs in eight engineering areas plus computer science. He has served as technical consultant for Emerson Electric Company, Allis Chalmers, Boeing Autonetics, Lawrence Radiation Lab, and ARAMCO (in Saudi Arabia). He is very familiar with the problems of engineers working in industry.

Ed Bertnolli advocates including practical papers and clear tutorial articles in IEEE publications and continuing edu-

cation that provides practical information for all engineers. He feels the cost of IEEE membership must be kept low and dues applied to rebates for local section/subsection member support. Dr. Bertnolli believes the IEEE should be a leader in advanced R&D in telecommunications, safe energy, computing, space, military and consumer systems.

Ed Bertnolli has the time, enthusiasm and support of his organization to be an active Region 5 Vice Chairman and Director. His candidacy is endorsed by the St. Louis Section IEEE and members of the Board of Directors of the Mid-America Electronics Conference (MAECON).



PENSIONS: LET THE ENGINEER BEWARE!

Reprinted from IEEE IMPACT, December 1983.

Since a Federal law was passed to provide the employee some safeguards in company pension plans, many engineers have relaxed and ignored or not bothered to read the fine-print details of their company pension programs. They feel they are protected. This is not necessarily the case, however, since there may be loopholes or weaknesses.

Some questions that every engineer should ask are:

- What happens to the money in my pension plan if I leave the company before retirement?
- Does my pension, if vested, continue to accumulate earnings? At what rate?
- What happens if I die before age 55 and have a vested company plan? Do things change if I am not employed by the company?

These are a few of the important pension questions. It is the engineer's

responsibility to know. An actual examination of the engineer's need to know these answers occurred in 1977. At that time, the projected payout for one engineer at age 55 was \$41,000. In 1983, when he reached age 55, the actual payout was reduced to \$25,000, of which \$20,000 had been paid in by the engineer from his income. He should have taken a cash payout and reinvested it. There was a similar type of reduction for the other engineer.

"It is the responsibility of engineers to know their own pension plan features and limitations, and they may suffer if they don't."

The Federal pension law does not automatically provide protection for you in all cases. It is the responsibility of

engineers to know their own pension plan features and limitations, and they may suffer if they don't. All engineers should become familiar with their pension plans, and we in PACE, the Professional Activities Committee for Engineers, will be asking engineers about their plans, so that they might avoid disappointments in the years to come.

The reason given for the decrease mentioned above is that the payout is based on a constant rate of monthly, annuity-type, payments. Since interest rates increased drastically between 1977 and 1983, the capital required became less. Bond-type, commercial annuities operate the same way. This really hurts the person who wants, or needs, a lump sum payout after interest rates have gone up. An additional question that needs to be answered is: is the lump sum payout increasing during the years that interest is falling?

The publication of *Engineers & Electronics* has been announced by the IEEE Press, book publishing arm of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). Authors of the book are John D. Ryder and Donald G. Fink.

Containing 204 photographs, tables and charts, *Engineers & Electronics* tells the story of how electrical engineering began modestly, then grew impressively into the technologies that today pervade all aspects of daily life. The book's time span is two centuries, although the authors focus their attention on the past 100 years. Emphasis is on developments in the United States.

The book is rich in descriptions of genius-innovators — Faraday, Edison,

Steinmetz, Tesla, Marconi, Babbage, Armstrong, plus many others, past and present. All aspects of electrical engineering are covered, including power, communications, entertainment electronics and computers.

Nontechnical matters are also treated, such as professionalism, engineering education and the history of the IEEE and its two founding societies, the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE), which joined forces in 1963.

Author John D. Ryder is a former Dean of the College of Engineering and Professor of Electrical Engineering at Michigan State University. Holder of 24 pat-

ents and author of seven textbooks in electronics and circuit theory, Dr. Ryder is a former President of the IRE and first Editor of the IEEE.

Author Donald G. Fink is a former Director of Philco-Ford Scientific Laboratories; an Expert Consultant, Office of the Secretary of War; and Editor of *Electronics* magazine. Holder of two patents, Mr. Fink has written or edited 13 books including McGraw-Hill's *Electronics Engineers' Handbook*.

Engineers & Electronics is clothbound and priced at \$29.95. IEEE members can purchase the book for \$17.95. This 251-page book may be ordered postpaid (Order No. PC01669) from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

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ENGINEER'S CALENDAR — SEPTEMBER 1984

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.

For information contact David Ferebee at 799-1071.

AEG

Association of Engineering Geologists.
Monthly meeting, September 5th. To be held at Capitol Federal Savings, 201 Wadsworth, Lakewood. For more information, contact Susan Steele at 623-2500 ext. 547.

AICHE

American Institute of
Chemical Engineers.

For information, contact Denise Goddard at 692-4185.

AIME/SPE

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

For information, contact Mike Jenecko at 825-1966.

AIPE

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

AIPG

American Institute of
Professional Geologists.

Monthly luncheon meeting, September 17th at the Denver Press Club. The speaker will be Professor Ken Kolm of the Colorado School of Mines. His topic will be "Wyoming Wind Corridor." For reservations, call 534-3667 by Thursday, September 13th.

ASCE

American Society of
Civil Engineers.

For information, contact Dave Sorenson at 320-6400.

ASHRAE

American Society of Heating,
Refrigeration and Air Conditioning
Engineers.

For information, contact Mike Ballard at 988-4514.

ASME

American Society of
Refrigerating and Air-Conditioning
Mechanical Engineers.

For information, contact Rob Hampel at 797-2455.

ASPE

American Society of
Professional Estimators.

September 11th - Holiday Inn North (I-25 and 48th Avenue) 5:30 p.m. social, 6:30 p.m. dinner, program to follow. For reservations and further information, contact Lynn at the ASPE office, 458-0465.

ASSE

American Society of Safety Engineers.
For information, contact Mike Clark at 575-3282.

CCEA

Colorado Chinese
Engineers Association.

For information, contact Dr. Paul Cheng at 977-1871.

CEC

Colorado Engineering Council.

Monthly meeting, September 12th. 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, September 25th at 3:30 p.m. To be held at the DAC. General meeting to be held on September 25th. 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 September include:

4th-5th — Defensive Driving Course — Open to the public. Evening classes 5:30-9:30 p.m.

6th — Forklift Truck Operators Instructors Development Course.

10th-14th — Safety Management Techniques (NSC).

19th-20th — Supervisors Development Program.

25th — Managing Motivations, Decisions and Communication (3rd of Four) III. Both Safety and Accidents are Personal Events.

26th — DDC — 8:00 a.m.-5:00 p.m.; Open to the public.

27th — Drinking, Driving & You, 8:00-10:00 a.m.; Open to the public.

28th — DDC II — 8:00 a.m.-12:00 noon; Open to the public.

26th-27th — DDC Instructor Development Course.

28th — DDC II Instructor Development Course.

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

CSE

Colorado Society of Engineers.

Monthly meeting, September 4th. To be held at the Landmark Inn. Cocktails at 6:30, dinner at 7:00 and program at 8:00 p.m. The speaker will be Neil Kelley from SERI. His topic will be "Wind Turbines." For reservations, call the CSE office at 426-5228 by August 31st.

CSNHR

Colorado Society of
Natural Hazards Research.

For information, contact Roy Spitzer at 744-7105.

DFCPEG

Denver Federal Center
Professional Engineers Group.

General meeting, September 19th. Cocktails at 11:30. For more information, contact Floyd Summers at 231-1147.

EXTRACTIVE METALLURGY CHAPTER OF DENVER

(ASM-AIMR/SME)

For information, contact Tom Grey at 771-3120.

IEEE

Institute of Electrical and
Electronics Engineers.

See RockIEEE Overlook beginning on page 10. Contact Craig Hartman for additional information at 987-4256.

IES

Illuminating Engineering Society.

September 11th — Topic will be "Local History of IES". For further information & reservations, call Darleen McGovern at 665-7116.

ISA

Instrument Society of America.

September 6th — For information and reservations, contact Anita Moxon at 296-1790.

PEC

Professional Engineers of Colorado.

Boulder Chapter

September 12th - 2290 Dartmouth Ave., Boulder (the home of Dallas and Nora Pat Fowler). Cocktails at 6:30 p.m. Authentic Chinese dinner served at 7:00 p.m. Program will be an illustrated talk entitled "Tin Mining in Indonesia" by Dallas Fowler, P.E.

Please call in your reservations by **Monday - Noon - Sept. 10th** to Dallas Fowler, 494-4943 or Bob Corning, 530-1451.

Comanche Chapter

Organizational meeting. We need everyone there. Details to be announced. For information, contact George Strain at 384-9452.

Jefferson Chapter

September 13th - Bernard's Restaurant, 5390 Wadsworth By-Pass. 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.

September 15th - Chapter Officers Conference hosted by Jefferson Chapter. Details pending. Contact the PEC office at 458-0465.

Metropolitan Chapter

September 19th - Quality Inn, 2601 Zuni St. 6:00-7:00 p.m. cocktails & dinner, program to follow. For further information, call the PEC office at 458-0465.

Northern Chapter

September 20th - Greeley - 6:30 p.m. For details and reservations, call Mike Ketterling at 351-0550.

Pikes Peak Chapter

September 11th - Social Meeting. Call Gregory Smith for details and reservations at 473-2300.

San Juan Chapter

September 20th - Contact Gerald Zink for information and reservations at 259-2869.

Southern Chapter

September 5th - Contact Mark White for details and reservations at 545-5660.

Ute Chapter

September 8th - Steak fry to be held at the Grant Moon home, 564 Normandy Drive, Grand Junction. For further information and reservations, call Bryant Rose at 242-5202.

PES

Pueblo Engineers of Colorado.

Monthly meeting, September 12th. Cocktails at 6:30, dinner at 7:00. For more information, contact Bob Erickson at 544-2791.

PI/USA

Packaging Institute of America.

For information, contact Charlie Brossia at 277-3433.

PLSC

Professional Land

Surveyors of Colorado.

For information, contact Robert Chichester at 756-3695.

RMAG

Rocky Mountain Association of Geologists.

Meeting dates for September include:

7th — Duff Kerr, of Kerr & Associates, Denver, will speak on "Paleotectonic Controls on Carbonate Development in the Central Williston Basin."

14th — Stephen A. Sonnenberg, of Bass Enterprises Production Co., Denver, will speak on "Tectonic and Sedimentation Model for D Sandstone Deposition, Zenith Field Area, Denver Basin, Colorado."

21st — Lorna A. Porter, of Porter Geological Corporation, Golden, will speak on "Potential for a New Stratigraphic Play in the Mississippian Midale, Eastern Williston Basin."

28th — Jon R. Ford, of Resource Technology Corp., Denver, will speak on "Influence of Precambrian Shear Zones on Paleozoic Rocks in Southeastern Colorado."

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

SAME

Society of American Military Engineers.
Dinner meeting, September 18th. Cocktails at 6:00, dinner at 7:00, and program at 8:00. To be held at Fitzsimmons Officer's Club. The speaker will be the Commander of the 2nd Space Wing - Colorado Springs Space Command and Operator of the Colorado Springs Space Center. His topic will be "The Ongoing Construction Plan and the Operations of the Center." 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.

September 18th - Brittany Hill Restaurant - Cocktails 6:00 p.m., dinner 7:00 p.m., program to follow at 8:00 p.m. The program topic will be "In Search of Excellence." Speaker to be announced. For further information and reservations, contact Pam Tarquin at 333-4504.

WIM

Women In Mining.

Monthly dinner meeting, September 12th. Cocktails at 5:30, dinner at 6:00, and program at 6:30 p.m. To be held at the Applewood Inn. The speaker will be Joy Fitzgerald, President of the National WIM. Her topic will be "A National View of Women in Mining." For more information, call Martha at 844-4481.

SAE

Society of Automotive Engineers.

September 19th - For further information and reservations, call Cathy Sherepita at 744-4647.

COLORADO SOCIETY OF ENGINEERS

Dinner Meeting September 4, 1984

Landmark Inn 455 South Colorado Blvd.
6:30 p.m. Attitude Adjustment 7:00 Dinner

Speaker: Neil Kelley, SERI

Topic: Wind Turbines

Howard McGregor - Program Chairman

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ELECTRICITY IN COLORADO

Continued from page 9

and began furnishing the first incandescent lighting in Colorado. The first incandescent lighting in New York was in 1877.

The West Side Station became the center of operations for Denver area

10,000-gallon steel tanks. The coal fires in these boilers were kept banked.

Lacombe Electric Company built a coal-fired plant at West 13th Avenue and the Platte River in 1890 where Indians had camped. It is now the site of the Zuni station which has two units of total capacity of 115,000 kilowatts.

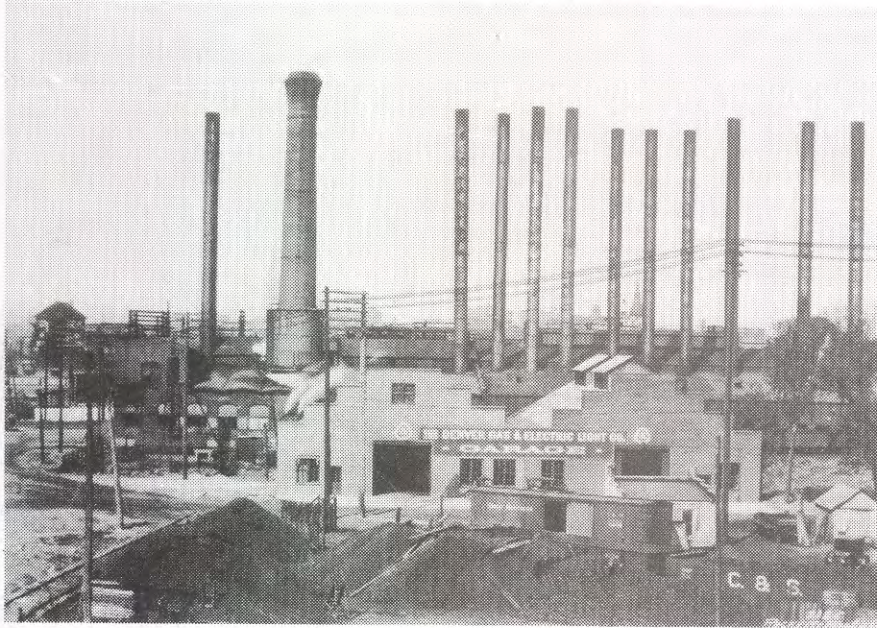


Figure 4. West Side Station, which was built in 1887, was the first to furnish incandescent lighting in Colorado.

plants, lines and interconnections with the Colorado Power Company hydro and transmission system. This was in 1909 and continued until 1924 with the start of the Valmont plant and merger of the Denver Gas and Electric Light Company, Western Light and Power Company and Colorado Power Company in 1923 and 1924. At that time, the dispatching and system operations were centralized at the Denver Terminal Substation of 100-kilovolt lines at West 13th Avenue and the Platte River.

West Side Station in 1910 had steam engine alternators (Figure 5), a 2,250-kilowatt vertical Curtis turbo-alternator and a 5,000-kilowatt turbo-alternator, a 1,000 kilowatt motor-generator, 250/500 volt d.c., for parallel operation with the machines in the basement of the new office building. There were 12 boilers, all hand-fired and coal-burning. Six were equipped with oil-burning apparatus to burn water-gas tar from the manufactured gas plant as fuel in case of emergency. Tar was stored in two

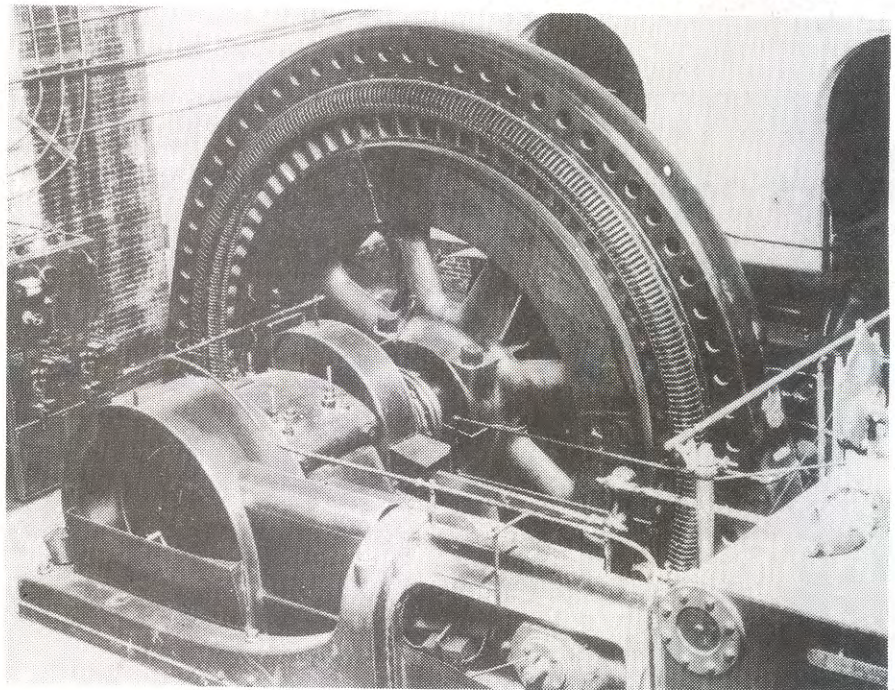


Figure 5. Filer, Stowall, Cross compound steam engine-generator at West Side Station.

A new building (Figure 6) was constructed at 15th and Champa Streets by the Denver Gas and Electric Light Company in 1910. It was lighted on the outside with 13,000 bulbs. There were two motor-generator sets installed. Electric trucks were used for service crews and commercial purposes (cover photo). This building was a prominent landmark from 1910 to 1962.

Northern Colorado Power Company

One of the first successful systems of control generation and transmission in the country went into operation in 1907 — the Northern Colorado Power Company. There were a number of isolated utilities in the area north of Denver. The plan was to build a modern steam generating plant at Lafayette in the northern Colorado soft coal fields with cooling water from a small lake. Power could then be transmitted to some nine towns with a 44-kilovolt loop and others with 13-kilovolt lines.

A plant was built in 1906 at Lafayette with much of the equipment which had been on display at the World's Fair in St. Louis and was the most modern at the time. There were two 3,000-kilowatt turbine-generators. The 44-kilovolt line was wood construction with iron insulator pins and steel braces. Burning of cross-arms and poles resulted, and wood braces solved the problems.

Most of the 44-kilovolt line was on the railroad right-of-way. The 44-kilovolt poles at a railroad crossing used special shielding by ground wires to protect the railroad from the 44-kilovolt line falling. The 150-mile, 44-kilovolt loop was completed in 1911.

The substation equipment at that time was indoor type, and the majority of the buildings were brick and concrete or metal. The 44-kilovolt bushings were insulated copper rods with small porcelain bushings where the rods passed through the cover. Insulated cables were used for 6.9 and 13.2-kilovolt feeders.

Figure 7 shows a typical 44-kilovolt substation. The 44-kilovolt conductors from the line passed through glass plates set in ceramic tile in the wall, and then to 44-kilovolt "grasshopper fuses" near the transformers. If the fuse blew, the fuse tube would fall open. The blown fuse could then be removed, refused, and replaced by an insulated stick which was part of the fuse assembly.

The 44-kilovolt lightning arresters at the rear of the building were a series of knurled brass cylinders with a small gap between them, and resistors in series to ground. They were quite effective.

The secondary circuits were fed through panel-mounted, manually-operated circuit breakers. In the early 1920s, some automatic reclosing breakers were added as shown in the foreground. The breaker is in the closed position and the round weight is down. If a fault occurred, the trip coils would trip the breaker from the weight. The motor would lift the weight through gears, latch the breaker arm and fall, closing the breaker with stored energy.

Note the lack of disconnects on the secondary breakers and feeders. These

were later rebuilt to add disconnects. This system became the Western Light and Power Company in 1914.

The Denver and Interurban Railway

The Denver and Interurban Railway Company was incorporated in 1904 to serve travel from Denver to Boulder, Longmont, Loveland, and Ft. Collins, where it owned a streetcar system. This would be a 71-mile route, and would be on or beside the tracks of The Colorado and Southern Railway. The D&I was a subsidiary of the C&S, and the Burlington Railway had bought control of the C&S. The final decision was not to extend the line beyond Boulder.

Discussions were held with General Electric Co. and Westinghouse Co. on the electric equipment when a great contest was going on over 550 volts DC by G.E. and 11,000 volts by Westinghouse. The high voltage line and trolley could transmit power over long distances without feeders and substations. Westinghouse was given the contract.

The Northern Colorado Power Co. was building a "large" coal burning, electric generating plant at Lafayette. It was contracted to supply power and build the overhead system. The D&I was to pay for power and 5% per year on the cost of the overhead. Two 25-cycle turbogenerators were purchased from Westing-

Continued on page 18



Figure 6. Denver Gas and Electric Company Building built in 1910.

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ELECTRICITY IN COLORADO

Continued from page 17

house by the Power Co. and installed in the plant. The route extended from a loop at 16th Street and Arapahoe Street, over tracks of the Denver Tramway Co. in Denver using 550 volts DC power to Globeville where the D&I tracks and 11,000 volts began and extended north to a junction near Broomfield. It then

went to Louisville and to Boulder Depot at 12th and Pearl Streets. It then turned south to Marshall, and back to the junction near Broomfield. A branch line went from Marshall to the resort town of Eldorado Springs.

This formed a route like a kite on a string and was known as "The Kite Route" with a total round trip of 57.24 miles.

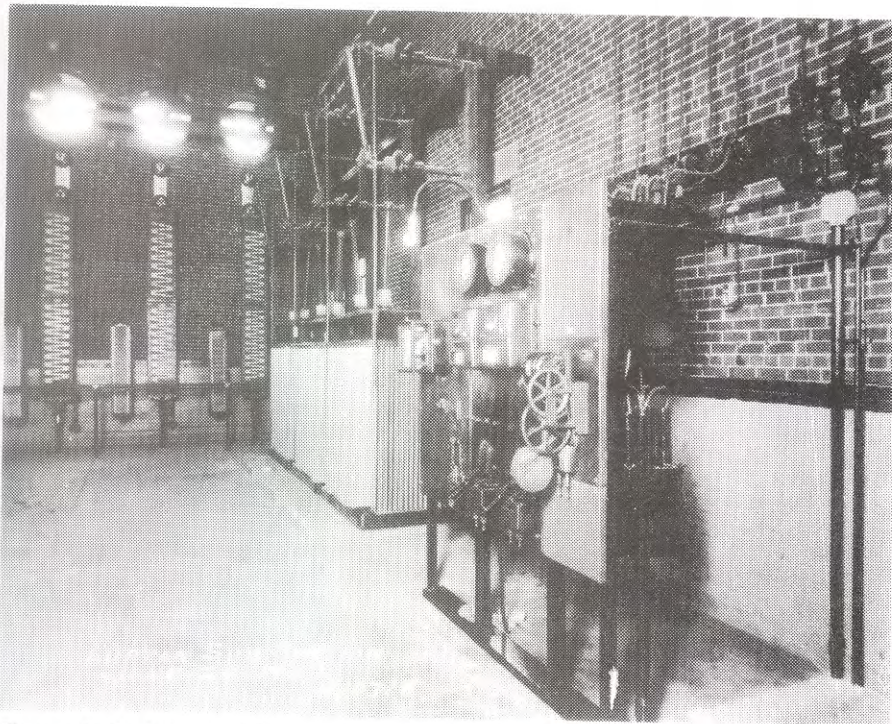


Figure 7. Ft. Lupton 44 k.v. substation on the 44 k.v. Loop built in 1911.

The matter of two voltages and DC and AC required some extensive research and development of motors, control, transformers, and equipment for the large, heavy, green, wood railroad cars. They had steel floors and roofs for safety from fire hazard. They were 55 feet long and motor cars weighed 125,000 pounds, and the trailers 66,250 pounds. A trolley pole was mounted on the roof of the motor cars at the rear for DC and a pantograph for AC on the front.

Operation started in 1908. First class service was given and was dependable and safe, and this system would be very valuable today.

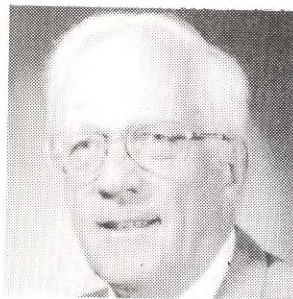
With the advent of hard-surfaced roads, increased use of personal automobiles, and severe competition of bus lines, the D&I never paid dividends on its stock and after 1914 it could not pay its mortgage to Guaranty Trust Co. of New York. It went into receivership in a foreclosure suit in 1918.

The street car system in Ft. Collins was sold to the city, but debts remained. The Manager, W. H. Edmunds, who had done an excellent job, was made Receiver in August of 1926. In December of 1926 the U. S. District Court granted permission to cease service which it did on December 15, 1926.

*Part Two of this series on **The Birth and Growth of Electricity in Colorado** will be in the October issue of WESTERN ENGINEER. It will cover "The Development of Hydroelectric Power in Colorado".*

ROBERT K. DOUGAN TO RETIRE

At a recent Board meeting Robert K. Dougan, CEO and Chairman of Robert Dougan Construction Company (AGC), Denver, Colorado, announced his retirement. Mr. Dougan will retain his responsibilities as Chairman of the Board. The company, founded in 1959, has projects throughout the Mountain States and will continue its growth as a leader in municipal construction.



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WIND TURBINE ACOUSTIC RESEARCH AT SERI

By Neil D. Kelley, Principal Scientist
Wind Energy Section, Solar Energy Research Institute

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SERI/In Review, May-June 1982.

An investigation into the extent and causes of acoustic noise associated with the operation of wind turbine generators has been undertaken by SERI's Wind Energy Section. Until the fall of 1979, acoustic noise from large wind turbines had not been a major concern. Early sound measurements of the first large prototype turbine (the DOE/NASA MOD-0 100 kW turbine installed near Sandusky, Ohio) indicated little chance for community annoyance at distances much beyond 6-8 rotor diameters (200-900 m). This situation changed, however, as the 2 MW MOD-1 turbine began undergoing operational tests near Boone, North Carolina.

SERI, in cooperation with NASA and the General Electric Company (the builders of the MOD-1), undertook a detailed study of the causes of a series of sporadic noise complaints from a few residents living within 2-5 km of the turbine installation. Since that time, considerable effort has been expended by a number of organizations in studying the MOD-1 situation in order to find out specifically what are the characteristics of the noise, its origin and production mechanism(s), its propagation path, and what can be done to eliminate or at least reduce it to below annoyance levels and to apply the knowledge gained in the design of later generation machines.

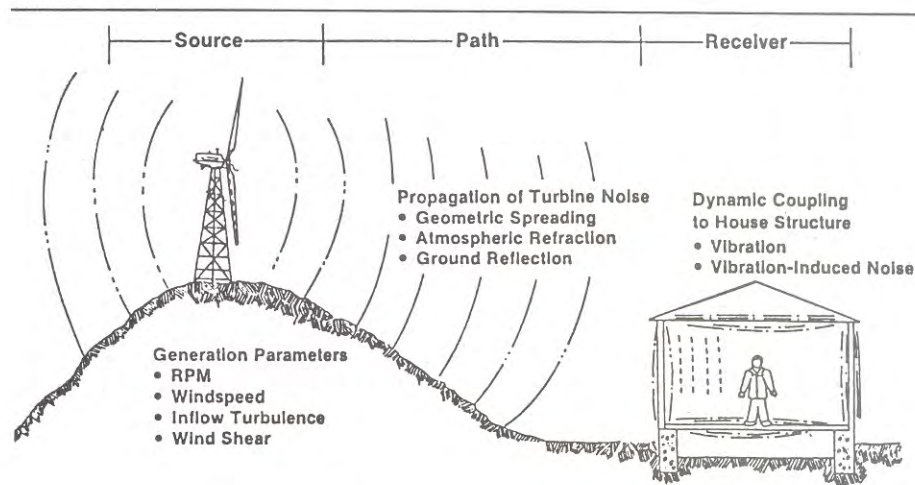
To date, acoustically-related annoyance from large wind turbines has been confined to a dozen families living within 5 km of the MOD-1 turbine. There have been no documented complaints of noise associated with the operation of any of the four smaller, 200 kW MOD-0A turbines or the 2nd Generation, 2.5 MW MOD-2 turbines installed near Goldendale, Washington. The SERI Group has recently surveyed both horizontal axis and vertical axis design wind turbines; i.e., the horizontal axis DOE/NASA MOD-0/A, MOD-1, and MOD-2 turbines and the 17m and 36m diameter Darrieus-type vertical axis turbines, the former built by the

Alcoa Company for the DOE/Sandia Labs and the latter designed by the National Research Council of Canada. This article summarizes some of SERI's findings related to acoustic noise generation by large wind turbines.

MOD-1 Noise Situation. After an extensive investigation of the acoustic noise associated with the operation of the MOD-1 turbine, the SERI team has concluded the annoyance of nearby residents is brought about by impulsive-type sounds which are produced as a result of the turbine blades passing through intense, viscous wakes downstream of the tower vertical support members. The interaction of the blades with these wakes causes a rapid fluctuation in the aerodynamic lift and the

way as to produce strongly oscillating or harmonic pressure fields within rooms of nearby homes creating the sensation of both noise (a low, "thumping" sound) and whole-body vibration. The SERI team recommended the installation of a specific type of aerodynamic spoiling device on the support tower to break up the two-dimensional structure of the viscous leg wakes into a three-dimensional, fully chaotic flow thereby substantially reducing the coherent noise radiation.

Coherent Noise Assessment Methodology. The SERI team has developed a technique to evaluate the level of low-frequency, coherent sound being radiated from a wind turbine under a given set of operating conditions. Such



Physical Parameters Responsible for the Generation, Propagation, and Perception of WECS Noise

radiating away of a sharp pressure pulse into the surrounding atmosphere. This acoustic pressure pulse has its peak energy associated at frequencies in the sub-audible range; i.e., below 20 Hz and specifically in the 8-10 Hz range. In addition, the energy in this pulse is radiated **coherently**; e.g., energy in various frequency bands is radiated into the atmosphere **simultaneously**. This impulsive, coherent energy has been found by the SERI researchers to interact with residential structures in such a

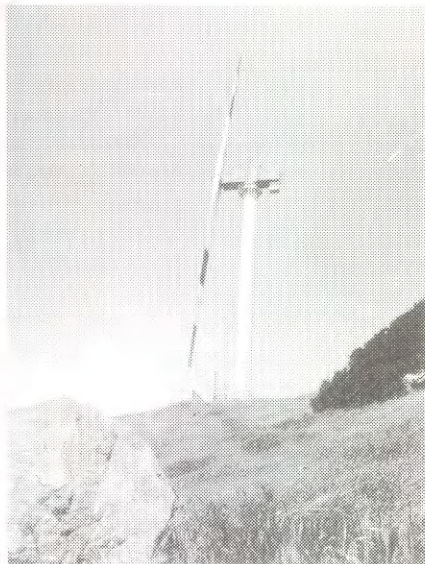
way as to produce strongly oscillating or harmonic pressure fields within rooms of nearby homes creating the sensation of both noise (a low, "thumping" sound) and whole-body vibration. This technique, which in effect measures the degree of phase coherency in the acoustic field being radiated, is

Continued on page 20

WIND TURBINES

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based on computing the joint probability distributions of the band pressure levels of a series of contiguous, octave frequency bands which are known to include the very lightly damped, structural resonances found in typical housing construction in the U.S. The results of

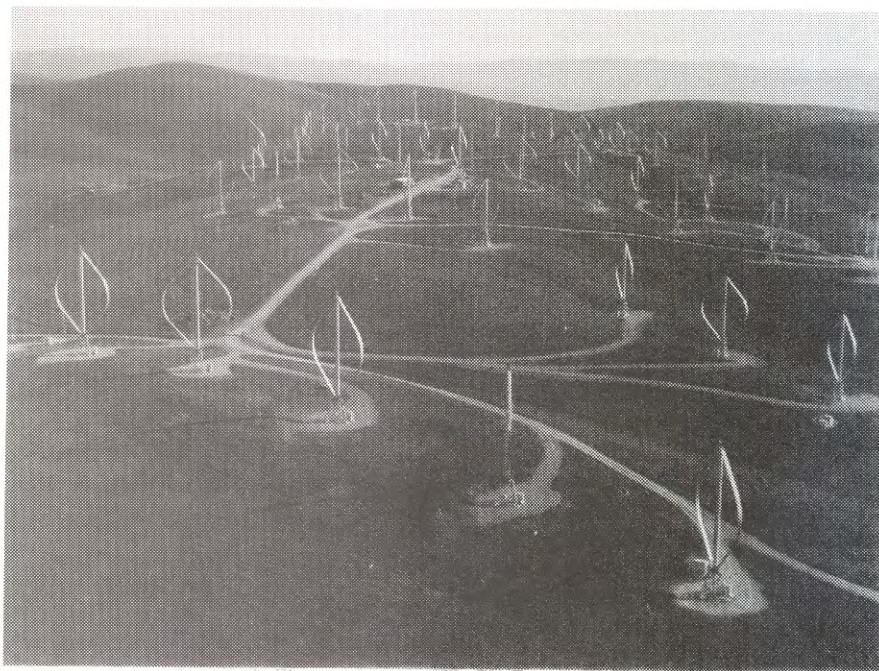


Boeing MOD-2, 2.5 MW Wind Turbine installed at Solano Hills, California for the Pacific Gas & Electric Co.

the acoustic surveying of the MOD-1 turbine and reduction by this technique are then used as reference points to compare other turbine designs.

Results of Acoustic Surveys of Other Turbine Designs. During the past two years, SERI has conducted acoustic surveys of the MOD-2 turbines at the Goodnoe Hills wind farm site near Goldendale, Washington and measured the acoustic output of two Darrieus-type vertical axis turbines; the 17m DOE/Sandia/Alcoa and the NRC/DAF 36m designs. The limited results of the

MOD-2 survey revealed no tendency for impulsive-type sound radiation as was associated with the MOD-1 turbine.



FloWind 160 kW Vertical Axis (Darrieus) Wind Turbines installed near Altamont Pass, California.

The vertical axis turbines, however, demonstrated that they are susceptible to impulsive noise generation depending on local atmospheric conditions; specifically the structure of the free-

"The impulsive, coherent energy produce(s) strongly oscillating or harmonic pressure fields within rooms of nearby homes. . ."

stream turbulence reaching the turbine rotor disk. With the demonstration that natural, atmospheric turbulence has a

pronounced effect on coherent and possibly higher frequency noise generation, all subsequent acoustic survey-

ing will include operational periods under a wide range of atmospheric conditions including daytime, early evening, and late evening hours.

Current Research Efforts. The SERI team is currently analyzing data from an extensive series of experiments conducted using one of the MOD-2 turbines in the cluster at the Goodnoe Hills Site. Specific goals of this experiment included the monitoring of the acoustic output of both single and multiple turbines under the atmospheric conditions mentioned above and to assess whether or not turbine array spacing has a significant effect on acoustic noise production; particularly coherent, low-frequency sound.

BITS AND PIECES

If you are driving on a road with beautiful scenery, unobstructed by signs and billboards, chances are you're on the wrong road.

A manager with seemingly average ability had moved up steadily to become a vice-president of his company. One day at lunch, a friend who hadn't seen him for several years asked him how he had accomplished his swift ascent through the ranks.

"I'll tell you," the vice president said. "When I started my first job, I gave my immediate boss's name to several executive recruiters. When one of the recruiters lured him away from our company, I moved up into his job. I've been doing the same thing with every boss I've had since."

When he is not studying quantum mechanics, advanced electronics or rebuilding personal computers, Kennis Koldewyn holds piano recitals for the Boulder public — a fine feat for a seventh-grader.

Achievement test scores place the 12-year-old Koldewyn at grade 12 and above in reading and science with almost 100 percent comprehension. At school, he sits in calculus and other advanced mathematics classes normally taught to older students in public schools.

At home, Koldewyn works problems and designs on the family's personal computer. The youngster uses an advanced programming language, which he describes as extremely fast.

So far as high-achieving students go, Koldewyn may be one of the lucky ones — his enthusiasm for learning has a channel at school and home. For many other such students, however, public school has become a form of national neglect, believes a Colorado State University professor.

"In our laudable attempt to improve things for students at the lower end of our schools, we've probably done a disservice to our brighter kids," said education Professor Bill Timpson.

Timpson pointed out that a recent federal report from the National Commission on Excellence in Education notes an overemphasis on remedial education and minimum standards.

Because secondary schools have limited resources for higher achievers, top-level students often are neglected in large classes or by teaching methods aimed at average students or children with learning problems, Timpson explained.

Recently Koldewyn joined more than 60 high-achievers from across the nation to go beyond their public school education. The students participated in college-level classes on advanced mathematics, science, critical thinking and expression through literature and arts.

"For many other such students, however, public school has become a form of national neglect..."

The students attended CSU's Summer Enrichment Program, now in its third year. CSU also holds shorter enrichment sessions for elementary school children and their parents.

This year, engineering subjects were added to the week-long event, said Timpson, who serves as program director.

Koldewyn described his week at CSU as a good experience.

"The professors made me think about things in science and technology I hadn't thought of before, such as how society and non-science people view high technology," he said.

Koldewyn and the others studied such topics as solar energy, fluid mechanics, computer-assisted engineering and speech analysis, and research on semiconductors and integrated circuits.

He says his week on campus fueled his enthusiasm for scientific tinkering. As a hobby Koldewyn invents new devices and modifies existing consumer products.

One of his more bizarre inventions, he noted, was a ketchup bottle fitted with valves that regulated the ketchup's flow from the hand-held dispenser.

A "better mousetrap"? No, says the budding engineer.

"It's totally worthless as a new product. I enjoyed building it because I could think out new dimensions to some complicated fluid dynamics problems," he explained.

Koldewyn eventually wants to produce something that benefits people, possibly in the growing field of biotechnology.

Until Koldewyn works out more complicated mathematical and engineering problems to design that beneficial component, Boulder residents may sit back and benefit from his next piano recital of works by Bach, Chopin or Mozart.

BITS AND PIECES

If you were to write down all the possible ways to motivate people to do better work, friendly praise would have to come near the head of your list.

That's fine, in theory. But do you actually practice it? Do you spend as much or more time praising the things people have done well as you do criticizing their mistakes or imperfections?

Unfortunately, most of us don't. Praise, when we give it, is short and sweet. Criticism tends to be long and detailed.

Actually, we'd get better results to reverse the procedure. Take the time to appreciate people's good points. Warm

them up with your sincere gratitude. Let them get the feeling of how pleasant it is to be praised for doing things well.

Then, when you come to the points that have to be corrected, lower your voice. You hate to do it — you know it isn't pleasant for them — but it has to be done. And let them know that you hope to be able to praise them for better results next time.

Leave people with the warmth of praise — and the prospect of earning more praise in the future — strongly in their minds. Avoid bitterness and scolding in your suggested corrections. There's no need for them — all they do is arouse resentment rather than the desire to cooperate.

When people take pride in their work, when they're doing a good job day in and day out, there is often a temptation

to take them for granted. Since they don't require constant supervision, it's easy to overlook their contributions. So check over the people who work for you every once in a while. Whom have you neglected to tell recently what a good job they're doing?

Obviously, some people need more attention than others. An insecure individual needs more frequent reassurances than a confident one.

Most employees don't need to be praised at every turn, but they do need frequent indications that their work is acceptable and appreciated. As a leader, praise — not criticism — is your most useful tool. Before you give a person a kick in the pants — no matter how well-deserved — raise your sights and try a pat on the back instead.

* * *

THE ENGINEER

By E. Leon Dalton

Reprinted from *THE ENGINEER'S BULLETIN*, November 1935.

Who comes with Faber sharpened keen,
With profile long and sober mien,
With transit, level, book and tape,
And glittering ax to swat the stake?

The Engineer

Who sets the level, bends his spine,
Squints through the glass along the line,
Swings both his arms at rapid rate,
Yells, "Hold that bloomin' rod up straight?"

The Engineer

Who raves and snorts like one insane,
Jumps in the air and claws his mane,
Whene'er he sees a scraper take,
A whack at his most cherished stake?

The Engineer

Who swears he'll charge an "even ten"
While on all fours he tries in vain
For stakes destroyed by mules and men,
To find the vanished stake again?

The Engineer

Who saws the air with maddened rage,
And turns with haste the figured page,
And then with patience out of joint,
Ties in another "reference point?"

The Engineer

Who calls it your "unrivaled gall!"
Whene'er you kick for overhaul,
And gives your spine the frigid chill,
Whene'er you spring an "extra bill?"

The Engineer

Who deals with figures quite profuse,
Then tells you solid rock is loose,
That hard-pan's nothing more than loam,
While gumbo's lighter than sea foam?

The Engineer

Who after all commands your praise,
(In spite of his peculiar ways)
While others harvest all the gains,
That spring from his prolific brains?

The Engineer

WORKSHOPS AND CONFERENCES

Continued from page 2

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November 8-9, 1984

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INTELLIGENT BUILDINGS AND INFORMATION SYSTEMS (IBIS) CONFERENCE

Hilton Hotel — Boulder, Colorado
September 16-19, 1984

The theme for IBIS '84 is "The Business Case" and the premise that the office building industry is struggling with both new building designs and the new technologies such as telecommunications, data processing, energy management, and other new technological innovations. The keynote speaker will be Dr. Francis Duffy - Duffy, Eley, Giffone & Worthington - Space Planners and Architects of London, England.

Sessions will include:

- New 'intelligent' building design and computer-aided design
- The 'new' telecommunications industry
- Trends in facilities management
- Managing the 'intelligent building' - new issues and services
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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.

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- Future successes in tele/conferencing

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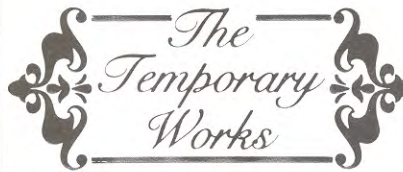
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