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## Duo quotations

## A few words from the editor

Ready links to the Calendar of Events for the following Sections are given in the anchor page (please click on the button)

**NEW YORK**
Long Island, North Jersey, New Jersey Coast & Connecticut

### Notable happenings in the month of June of years past
Events and birthdays of the giants on the shoulders of whom we stand today

### News from the NY Section and the IEEE

- New Senior members
- Obituary: Irwin Weitman
- PERC PE Review Course Announcements
- Free online books from the IEEE-USA

### Thermal Ratings of Cables in Unfulfilled Troughs
Matthew Terraciano, Graduate Student Member, NYU-Poly

### You are assigned a project, what now?
Dr. Edward Farkas, M, PMP

### Saving History,
The story of Edison Dynamo No. 16
Robert Lobenstein
Introduction by Mel Olken and Charles Sulzberger

### Travel and Leisure

- **A Journey through Galapagos**
  Dr. Lewis Terman, LF,
  2008-president of the IEEE and IBM Research Emeritus
  Donald M. Kendall Sculpture Gardens, Purchase, NY

- Dr. Amitava Dutta-Roy, LF, Editor Review
  “BodyMedia” for Your Health Management
Contributors and collaborators:

The Monitor thanks all contributors and collaborators towards the compilation of this edition of the Monitor: Mr. Edward Farkas, M; Mr. Matthew Terraciano, Graduate Student Member, Mr. Robert Lobenstein, Mr. Carl Sulzberger, Associate History Editor, Power & Energy Magazine and Mr. Mel Olken, Fellow, Historian – New York Section and Editor-in-chief of the Power & Energy magazine; and Dr. Lewis Terman, Life Fellow, 2008 IEEE president and IBM Research emeritus.

Spread the news among your family, friends, colleagues and the community that we, at the IEEE, are dedicated to advancing technology for humanity.

The IEEE, world’s largest professional association was founded by engineers, is run by engineers for engineers to advance technology for humanity.
Duo quotations of the Month

“...I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers your knowledge is a meager and unsatisfactory kind; it may be the beginning of knowledge but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be.”

Lord Kelvin (William Thompson, 1824-1907)
Lecture to the Institution of Civil Engineers, May 3, 1883

Photo: IEEE Global History Network (GHN)
Not everything that can be counted counts, and not everything that counts can be counted.

Attributed to Albert Einstein*

Notes on quotation attributed to Albert Einstein

Quote Investigator: QI suggests crediting William Bruce Cameron instead of Albert Einstein. Cameron’s 1963 text “Informal Sociology: A Casual Introduction to Sociological Thinking” contained the following passage [WCIS]:

It would be nice if all of the data which sociologists require could be enumerated because then we could run them through IBM machines and draw charts as the economists do. However, not everything that can be counted counts, and not everything that counts can be counted.

There are several books that attribute the quote to Cameron and cite this 1963 book. QI was unable to find earlier instances of the saying. Researcher John Baker identified this citation, and it appears in the internet compendium WikiQuote.

This maxim consists of two parallel and contrasting phrases:

Not everything that can be counted counts.

Not everything that counts can be counted.

The position of the two key terms “counted” and “counts” is reversed in the two different phrases. This rhetorical technique is referred to as chiasmus. QI hypothesizes that the two phrases were crafted separately and then at a later time combined by Cameron to yield the witty and memorable maxim.

Juxtaposing the duo quotations were conceived and researched by Dr. Al Wald, LSM and a former editor of the IEEE EMBS Magazine
A few words from the editor

In January 2011 I was designated as the editor of the Monitor by the IEEE’s New York Section. It’s time that I take stock of my performance. Since the first issue of the Monitor I have tried to make it more user-friendly and interesting. Sometimes it worked and other times it didn’t. I included a mix of techno-informational items suitable for our heterogeneous readership and reviews of products, Web sites and books. I introduced tips on leisure and cultural activities in and around New York City thinking that engineers too need to relax.

In my endeavor I had a few clear-cut objectives in mind. One of them was to encourage younger members to contribute articles to the Monitor. In my 25 years of writing in public magazines I have seen articles written by the young people — perhaps for their first time — rejected because they did not pass the rigorous test of the IEEE’s learned journals. The rejected authors are sometimes so traumatized that they may never submit other articles. I felt that offering space on the Monitor to young engineers would be in line with the IEEE’s policy of extending education and communications. In this issue you will find such an article by Matthew Terraciono who is a graduate student member of the IEEE and a candidate for PhD at NYU-Poly. The topic of his paper is highly specialized and may not be everybody’s cuppa’. But I hope that Terracino while preparing his article has learned a little about writing and editing and that may give him the necessary confidence in himself to write more in the future. That gives me much satisfaction. Moreover, Terracino can always refer to the paper in his resume. Monitor is scanned by Web search engines and archived for posterity. My efforts in this direction are also in line with the IEEE’s commitment to help engineers in their careers. The story of personal research projects that a 2012 IEEE Fellow contributed to the Monitor too should have inspired the young to continue with the engineering profession.

I solicited more experienced members to contribute articles that I thought would be interesting to the readers inside and outside the IEEE. These articles have been most informative and could help the younger folks to learn from them. In the present issue of the Monitor you will find an article contributed by Dr. Edward Farkas, an IEEE member and consultant. Dr. Farkas worked for the Port Authority of New York and New Jersey for many years and the author of two books. Dr. Farkas offers his advice on getting a job well done to the ultimate satisfaction of the client.

I wanted to bring the life members to the folds of the Monitor. The life members now live longer and are capable of working harder. Today’s 80 is yesterday’s 60. I wanted to send a message to the mainstream of the IEEE that its life members are not disposable commodities. They can still contribute much to the IEEE sharing their wisdom and experience by counseling, mentoring, teaching and working for IEEE’s community service projects worldwide. Amongst many life members a past IEEE president (Dr. Lewis Terman, LF, president in 2008), a future president (Dr. Peter Staecker, LF, president-elect for 2013), a director Emeritus (Mr. Eric Herz, LF), all three members of the august body of the IEEE board of directors, and a former editor of the Spectrum magazine (Dr. Donald Christiansen, LF) are living proofs of their continuing dedication and contribution to the IEEE. I am happy that some life members of this and other branches of the IEEE including John Meredith, 2007-president of the IEEE-USA and Dr. Staecker, appreciated the contents and layout of the Monitor and thought the to be fit for their contributions articles and presentations. Michael Miller is veteran statesman of the New Section kindly introduced me to other life members. I eagerly grabbed his helping hand. I hope that life members will continue to write about their experiences in their profession and life.
The IEEE president for 2011 Dr. Moshe Kam also wrote a New Year (2012) message exclusively for the Monitor readers. In this edition you will find a short travel journal and photographs taken by the 2008 president Dr. Lewis Terman, LF and IBM Researcher Emeritus.

In April of this year I introduced a section on notable happenings. I strongly believe that we are privileged with the marvels of technologies because of the giants of the past on the shoulders of whom we stand today. Facebook owes its roots to George Boole (November 2, 1815 – December 8, 1864), a British mathematician. Many of the modern comforts we take for granted were conceived by great inventors such as Thomas A. Edison and Alexander Graham Bell. That is why I am indebted to our historian Mel Olken and Gil Cooke, historian of the Boston Section to let me post their articles on history of technologies.

Last month it was the first time that an audio-video presentation (1 hour and 5 minutes long) was imbedded in the Monitor. I thought that it would be good if denizens of the NY Section and IEEE members in general got to know about our worldwide humanitarian efforts that are being undertaken by a most dedicated IEEE team of the Engineering Projects in Community Service (known as EPICS-in-IEEE) initiatives that are still very little known within our engineering communities. One step at a time!

Overall there were some 22,000 hits on the site during this year alone and in last May that number topped 1,500 in one single day. The comments left on the site were generally encouraging.

At a very young age I was taught by my parents the crux of Indian philosophy that nothing in this life is permanent. Things do change constantly. Sometimes they make a circle and come back, other times like many comets they go straight into oblivion never to be seen again. All this makes life so interesting. Nothing is permanent in the Monitor either. In the case of the Monitor the leadership of the New York Section thought that the Monitor needed a change of the occupant of the cockpit. Hence, this issue will be the last one edited by me. At this juncture I take the opportunity to thank all contributors, collaborators, colleagues and other well wishers. We have never taken a poll on reader satisfaction but from the many emails I received during the last sixteen months it is clear to me that I did not do such a bad job. I bow to thank all of you. To those who were not happy with my performance I can only say that I am sorry that I could not come up to the level of your expectation. Had the Section leadership and members in general taken the time to contribute more perhaps the Monitor would even be better. I am cognizant that publishing is a serious business and any publication that has the IEEE logo on its pages presents our public face and must project the exacting professionalism that engineers are usually proud of. And I did my best to honor that call of responsibility. I spent many long hours in doing what I did. I wish I could do even more.

But not to worry! Whoever sits in the pilot’s seat next will surely wear four gleaming stripes and you can expect a better Monitor though presumably with a different focus.

As a young lad I also learned that everything in life has an upside. For the last year and a half I have been relentlessly chasing potential authors both inside and outside the IEEE, sometimes begging them to write; I was able to convince former and future IEEE presidents to contribute to the Monitor; I have scoured the magazines and the World Wide Web in search of authors; and bugged the IEEE staff for information that would be interesting and useful for you. It has taken a toll on my time. So, for me the upside of exiting the cockpit is that for a brief period, at least, I will not have to stay up until the wee hours of the night editing articles and copy-pasting pictures. I will have the time to enjoy all that my adopted city has to offer during the coming summer months. But twenty five years ago I was bitten by the writing bug. My father was a writer first and a lawyer later. Writing is in my DNA. So, in the near fu-
ture I will again be pounding on the computer keyboard writing stories and product, book reviews and about interesting Web sites. I do not yet know exactly where I’ll park myself. Technologies are agnostic. They don’t care about your origin, looks, skin color, age or even your faith. Writing about them demands patience, curiosity and intellectual perseverance. But if you keep in touch with me I would let you know in which basket I put my humble efforts again in gears. You know where to get me … the IEEE that has been my virtual professional meeting place for the last 40 years.

So, my patient and kind readers, and friends, for the time being let me just say: Goodbye until we meet again through the pages of my next bookmark. Keep well and do good work for the IEEE! And . . . in the meantime, do enjoy the summer!!

Lincoln Center is a cultural landmark of New York City. The photographs show the windows of the Lincoln Center Theater . . . Photo collage: Amitava Dutta-Roy
Dates to remember in June

June 1: 1907: Frank Whittle (d. August 9, 1996): English aviation inventor of a jet engine

June 3, 1947: John Dykstra, pioneer in the development of computers in filmmaking for special effects

June 3, 1875: For the first time Alexander Graham Bell and Thomas A. Watson transmitted speech sounds electrically

June 4, 1910: Sir Christopher Cockerell (d. June 1, 1999), British, inventor of Hovercraft

June 6, 1436: Johann Muller (d. July 6, 1476), German astronomer who invented astronomical tables

June 6, 1850: Karl Ferdinand Braun (d. April 20, 1918), German scientist who invented the first oscilloscope aka the Braun tube, and invented a form of wireless telegraphy, Nobel Prize 1909

June 6, 1933 Heinrich Rohrer (Swiss physicist who co-invented the scanning tunneling microscope in 1981, providing the first images of individual atoms on the surfaces of materials, Nobel Prize 1986.

June 7, 1502 (not exactly known: Pope Gregory XIII (d. November 28, 741) invented the Gregorian calendar in 1582

June 7, 1886: Henri Coanda (d. November 25, 1972), Romanian inventor and aviation scientist who designed early jet engines

June 7, 1896: Robert Mulliken (d. October 31, 1986), American chemist and physicist, who was behind the early development of molecular orbital theory, Nobel Prize 1966.

June 11, 1895: Charles Duryea(December 15, 1861 – September 28, 1938), American inventor received his patent for a gasoline powered automobile.

June 11, 1915: Birthday of Nicholas Constantine Metropolis, developer of MANIAC, a computer used to develop with the hydrogen bomb.

June 11, 1895: Charles Duryea (December 15, 1861 – September 28, 1938), American inventor received his patent for a gasoline powered automobile.

![Image of an early gasoline powered automobile](image)


June 13, 1773: Thomas Young (d. May 10, 1829), British philologist and physician who established the wave theory of light.

June 13, 1831: James Clerk Maxwell (d. November 5, 1879): Scottish physicist who discovered the electro-magnetic field.

![Image of James Clerk Maxwell](image)

June 13, 1854: Charles Algernon Parsons (d. February): British inventor of the steam turbine

**June 14, 1736** Charles-Augustin de Coulomb ((d. August 23, 1806): French physicist who wrote Coulomb's Law and invented the torsion balance.
June 15, 1844: Charles Goodyear (December 29, 1800 – July 1, 1860), American inventor was granted the US patent #3,633 for vulcanized rubber.

June 17, 1980 Atari’s "Asteroids" and "Lunar Lander" are the first two video games registered as copyright.

June 18, 1935 ROLLS-ROYCE was trademark registered.

June 19, 1623: Blaise Pascal (d. August 19, 1662), a philosopher and mathematician who invented the first mechanical calculator, known as Pascaline.

June 19, 1900: Mihajlo Idvorski Pupin (October 9, 1858 – March 12, 1935), Serbian-American physicist is granted a patent for long distance telephony.

June 20, 1840: Samuel Finley Breese Morse (April 27, 1791 – April 2, 1872), American, was granted a patent for telegraphy signals.


© Rolls Royce Motors
Source: www.ro Balkroycemotorcars.com
June 22: 1910: Konrad Zuse (d. December 18, 1999), German civil engineer and computer pioneer who invented the first freely programmable computer.

June 23, 1912: Alan Turing (d. June 7, 1954), British mathematician and computer theory pioneer, who invented the Turing Machine.


June 24, 1883: Victor Francis Hess (d. December 17, 1964), Austrian-American physicist who discovered cosmic rays, 1936 Nobel Prize in Physics


June 24, 1915: Fred Hoyle (d. August 20, 2001), British cosmologist who proposed steady-state universe theory.

June 24, 1927: Martin Lewis Perl, American physicist who discovered the tau lepton, Nobel Prize 1995.

June 25, 1894: Herman Oberth (d. December 28, 1989), German rocket scientist who invented the V2 rocket.

June 26, 1824: William Thomson Kelvin, later Lord Kelvin (d. December 17, 1907), British physicist who invented the Kelvin Scale. (Please see the duo quotations section for a photo.)


June 28, 1956 First atomic reactor built for private research starts operations in Chicago.

June 29, 1858 : George Washington Goethals (d. January 21, 1928), American civil engineer who built the Panama Canal.

June 30, 1896: William Hadaway of New York, NY was issued a patent for the electric stove.
News from New York Section and the IEEE-USA

Senior Members

The IEEE Admissions and Advancement Committee of the IEEE at the Tokyo meeting held on June 2, 2012 upgraded Martin Frank and Bowen Zhou of the New York Section to Senior Membership grade of the IEEE. The Monitor congratulates both of them. Well done!

Please note that the next meeting of the committee is scheduled to be held on June 30 in Boston.

Obituary

It is with deep sadness that I inform you of the passing of Irwin Weitman, a long time PACE activist and Consultants Network pioneer. Irwin was a warm-hearted engineer who loved his work, and made great contributions to the IEEE. All of his friends here at the Long Island Section will miss him dearly.

Professional Engineers Review Course (PERC)

Those of you interested in becoming a licensed professional engineer or renewing your license can now take advantage of the review courses administered by PERC Inc. Traditionally, these courses have regularly been offered to the IEEE members, announced in the Monitor pages and in the past were well attended. The details of the courses (beginning in July 2012) that will be offered in the near future are given in a pdf document. Please click on the link below and you will be automatically whisked to the PERC pages.

Good luck!


Free e-book offer from the IEEE-USA
WASHINGTON (22 June 2012) -- IEEE-USA, as a special benefit to IEEE members, is giving away a free e-book in June and July. "Launching Your Career Book 1: How to Find Your Perfect Job" is the June giveaway. This e-book will help you define your personal, long-term career goals and provide a practical roadmap to assist in finding your ideal job. Author Abby Vogel Robinson provides tools and assessments to enable you to evaluate your personality and aspirations, find a great company to work for, choose the best position for you and build your network. Your career decisions will play a major role in determining your income, community status, circle of friends, choice of a spouse -- and even your identity and sense of self-worth. It will also help you choose wisely and carefully and get you started toward personal and professional fulfillment.


In July, IEEE-USA's free e-book will be "Personal Positioning for Engineers." This publication is designed to help you learn more about employment options available to engineers. You will also learn how to position yourself for success by choosing the right options for you.

"The key to succeeding is to understand yourself, how you respond to change and what level of risk you can deal with," author Paul Kostek writes.

This e-book will be available for members to download for free in July.

To purchase IEEE member-only products and to receive the member discount on eligible products, members must log in with their IEEE Web Account.

Call for Authors
IEEE-USA E-books seek authors to write an e-book or a series of e-books on career guidance and development topics. If you have an idea for an e-book that will benefit members on a particular topic of expertise, email your e-book proposal to IEEE-USA Publishing Manager Georgia C. Stelluto at: g.stelluto@ieee.org.

IEEE-USA advances the public good and promotes the careers and public policy interests of 210,000 en-
Graduate student paper

Thermal Rating of Cables in Unfilled Troughs
Matthew Terracciano*

Underground cable installations are substantially more expensive than overhead transmission lines for the same power capacity. Despite the cost factor, underground cables are preferred in densely populated cities because of safety, reliability and aesthetic issues. One of the most important technical challenges that designers of underground cable systems face is the thermal rating of the cables. The temperature rise in the cables determines the gauge, and therefore the price, of the cable.

The maximum current that a transmission cable can carry safely depends on how efficiently the inherent cable losses can be dissipated. Cables are installed in varied arrangements in either air or under the ground. Directly buried cables constitute most common form of underground installation. However, cables can also be installed in duct banks, in backfills, in filled or unfilled troughs, in tunnels or in casings, etc. Environmental constraints (such as the need to cross a river) may require that cables are installed in tunnels or troughs. In such situations it is particularly important to use accurate thermal rating methods because of the high cost of installations. Any added cost due to conservative cable ratings would significantly inflate the total price of a cable run installed in a trough.

This paper discusses the limitations of the currently available techniques for rating cables installed in unfilled troughs. It has been found that the standardized formulas predict temperatures that are too optimistic. Therefore, a new method, compatible with the standards, is proposed in this paper. The Fi-
nite Elements Method (FEM) is used to establish the range of validity of the standardized formulas and compared with those for the model proposed in this paper. FEM is a computer simulation technique that is recognized as representing the closest possible physical phenomena. All physical complications of real cable installations may be represented by constructing the relevant heat transfer problem at the field (point) level. The nonlinearities produced by convection and radiation can also be properly represented. There is no need to make any simplifications with regard to the geometrical arrangements. Circles inside rectangular shapes limited by flat and infinite surfaces present no major modeling challenges.

The currently used (worldwide) cable rating techniques can be found in IEC Standard IEC-60287-2-1. In Section 2.2.6.2 an empirical formula is given to rate cables in unfilled troughs that have the top flush with the soil surface. The temperature rise of the air inside the trough above (external) air ambient is given by: \[ \Delta T = \frac{W_{TOT}}{3p} \]

Where \( W_{TOT} \) is the total power dissipated in the trough per unit length [W/m] and \( p \) [m] is that part of the trough perimeter which is effective for heat dissipation. These techniques, adopted by the IEC as standard practice for cable rating, are considered to be inaccurate since they do not account for many of the physical phenomena that contribute to a cable's thermal performance. Hence, the results of the calculations are questionable. The standard body itself accepts that the validity of the formula is currently under investigation.

To establish the accuracy of the formula we compare the results against hundreds of transient finite elements (FEM) simulations while varying parameters such as: (a) trough size (perimeter); (b) ambient air temperature; (c) cable operating temperature (total losses); (d) trough aspect ratio; (e) position of cables; and (f) effects of solar radiation. The goal is to propose a physically consistent analog thermal-electric equivalent circuit for the thermal rating of cables installed in unfilled troughs. In contrast with the standards model, the new equivalent circuit offers a methodological approach that considers all heat transfer phenomena involved with cables in troughs, such as the conduction of heat through the cable layers, the heat convection and radiation inside the trough, the conduction through the trough itself and soil, the convection to the surface air, and solar radiation. The same transient finite element simulations are used to verify the accuracy of the proposed equivalent circuit.
Fig. 1. Unfilled trough with lid flush with the soil surface.

The physics involved in the air flow within an unfilled trough is dominated by temperature (and ultimately density) differences in the surrounding air which create the natural convection as seen in Fig. 1. The fluid flow within the trough can be extremely chaotic and unpredictable (Fig. 2). It might require more than a month before a steady-state temperature can be reached. This is evident from the line termed non-adiabatic in Fig 3. Simulation of this natural phenomenon requires very powerful computers and long computation times. The current state of technology that uses finite element simulations,
although extremely accurate, is unrealistic for rating cables and thus there is a need for easier implementations that can still retain the accuracy but demands less computational power and machine time.

Fig. 3. Plot of temperature vs. time for air adiabatic, trough adiabatic and non-adiabatic conditions

Transient FEM simulations assume a soil ambient temperature of 20°C, and continue until a steady state is reached as in Fig 3. In any such simulation process it is important to properly deal with the unpredictability of local vortexes of the air convection process in the trough. The finite element simulations are performed using the conjugate heat transfer module of COMSOL Multi-physics program that takes into account conduction, convection and radiation of heat. Using such powerful tools we can study which areas of interest have a significant impact on the maximum temperature of the cable and which do not. The thermo-electric model we have proposed is tested using the same simulation tools to determine its accuracy.

Numerous simulations were performed to study the effect of different perimeter lengths on the maximum temperature reached within the trough during an assumed experimental period of two days.
and these simulations assumed the use of identical cables at ambient temperatures of 20, 32, and 45°C with varying losses calculated with IEC standard 60287 to obtain a maximum temperature of 90°C. The results of these simulations, shown in Table I, reveal that the IEC Standard method is adequate for relatively small troughs (perimeter 1m) for short periods of time. However, the method is not accurate for larger troughs, where the errors could be close to 15% on the optimistic side. This means that the standard methods dangerously under-predict the operating temperature of the cables. The Table also shows the results of the proposed thermo-electric model developed for this work. It is evident that our model matches very well with the FEM simulations.

In order to investigate the effects of the trough's aspect ratio the width and height of the trough was varied while the perimeter \( p \) was held constant (Fig. 4). Eighteen troughs of different aspect ratios were simulated assuming constant losses and for two different ambient temperatures of 32°C and 45°C.

<table>
<thead>
<tr>
<th>Perimeter Length [m]</th>
<th>Trough Dimensions</th>
<th>Ambient Temp. [°C]</th>
<th>Losses [W/m]</th>
<th>Non-Adiabatic Finite Elements 2-Days Temp. [°C]</th>
<th>IEC Standard Calculations [°C]</th>
<th>Circuit (Fig. 8) 2-Days</th>
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<tr>
<td>1</td>
<td>0.32 0.34</td>
<td>20</td>
<td>62.07</td>
<td>93.16</td>
<td>90 -3.40</td>
<td>93.40 0.25</td>
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<tr>
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<td>0.32 0.34</td>
<td>45</td>
<td>38.31</td>
<td>91.26</td>
<td>90 -1.38</td>
<td>91.11 -0.16</td>
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<tr>
<td>1</td>
<td>0.32 0.34</td>
<td>32</td>
<td>50.45</td>
<td>92.15</td>
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<td>20</td>
<td>78.32</td>
<td>99.65</td>
<td>90 -9.68</td>
<td>97.67 -2.03</td>
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<tr>
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<td>32</td>
<td>63.70</td>
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<tr>
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<td>96.62</td>
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<td>100.90</td>
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<td>104.81</td>
<td>90 -14.13</td>
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</tr>
</tbody>
</table>

The results confirm that, as inferred in the IEC standard, the aspect ratio does not have an important effect on the maximum temperature attained. The results of this simulation experiment are shown in the plots of Fig. 5 and these plots demonstrate that the different realistic aspect ratios change the steady-state temperatures only by a few tenths of a degree.
Fig. 4. Troughs flush with the soil showing the isothermals. (a) Small aspect ratio 0.22; (b) Large aspect ratio 2.25.

Fig. 5. Aspect ratio versus maximum conductor temperature for ambient temperatures of 45°C and 32°C.
As per IEC Standard 60287, the cable temperature (or ampacity) is impacted by the distance between a cable and the vertical wall of a trough. That standard does not mention for the horizontal position of the cable in the trough, whether it is near the top, center, or it rests on the floor. It can be seen in Table II that on an average the maximum temperature reached during steady state decreased by 13.54% when the cable was positioned on the floor of the trough. Several simulations were also performed to study the effects of cable position when not in direct contact with the floor. A single cable with constant losses was moved to different horizontal and vertical positions within a trough of constant size and ambient temperature with the results shown in Fig. 6. The most significant difference in (steady-state) temperature of 5.32%, compared with the results from the IEC standard, occurred when a simulated cable was at the closest to the ceiling of the trough, limiting air flow around the cable. This, difference, however, is not a significant and is an unlikely situation for practical purposes. Further research is necessary before drawing any definitive conclusions.
In order to account for the effects of solar radiation on the temperature within an unfilled trough the standard states, "any portion of the perimeter, which is exposed to sunlight is therefore not included in the value of $p$." In our case, since we assume that the trough is flush with the surface, we excluded the lid from the trough perimeter $p$ from the standard formula. This exclusion increases $\Delta T$, thereby increasing the effect the trough on the maximum temperature attained by the cable. In order to find the real effects of the sun on unfilled troughs, simulations were run using a “half wave bridged sine wave” sun model to mimic the incident heat flux on the soil and trough surface due to the sun. Fig. 7 shows the temperature swing in the trough associated with the variations of the intensity of solar radiation during the course of a day. A detailed view of 3 days of temperature rise and fall can be seen in the insert on the graph. In Fig. 7 the ends of the 1000W, 750W and 500W plots have been cut so the full temperature swings can be seen in the graph. The physical characteristics of the materials used in the lid of the trough as well as the soil also play a large role in the temperature swing within the trough. The large amount of variations in the parameters during any one day makes the simulations very time-intensive. However, the results shown here are helpful when developing the equivalent thermo-electric circuit seen in Fig. 8.
Fig. 7. Maximum temperature as a function of time showing the effects of solar radiation incident on the trough lid and surrounding soil.

Fig 8. Thermal circuit for cables in unfilled troughs
Fig. 9. Temperature swing within trough due to solar radiation from FEM and Thermal Circuit.

From first thermodynamic principles a model to properly represent the heat transfer phenomena of cables in unfilled troughs has been derived that accounts for not only daily variations in the solar radiation but also for material properties of a trough and the soil and. The proposed thermal model is a circuit as shown in Fig. 8; it consists of a set of series resistances, shunt capacitors, and heat sources. The circuit considers all the elements involved in the familiar heat transfer problem. The following components are represented in the model:

1. the cable (only the conductor and insulation are depicted in Fig. 8, but the method is compatible with the models of all complex cable constructions supported by the IEC standards by substituting the appropriate circuit model in the region marked “cable.”;

2. (heat) convection of air in the trough;

3. (heat) radiation from cable to trough; the trough thickness and material; the soil;

4. intensity of solar radiation;

5. (heat) convection to the open air; and

6. the ambient temperature. Voltage at each node represents the temperature of the particular component in the circuit.

To investigate the accuracy of the circuit in Fig. 8, the results obtained from the proposed model are compared against the same finite element simulations used for the IEC standard method. The com-
parative figures are shown in the last two columns of Table I. The results show a very good match with respect to FEM; the maximum error is less than 4%. To further validate the model a set of transient experiments including the cyclic variations of the intensity of solar radiation were performed. The comparison of the results between the model of Fig. 8 and the results from FEM for different intensities of solar radiation are presented in Fig. 9. The maximum error at the upper and lower peaks is 5.24%, which is very good considering the complexity of the physics involved in the analysis of heat transfer in unfilled troughs.

Using hundreds of finite elements simulations the validity range of the standardized equations for rating cables in unfilled troughs has been established. The IEC method works well, for short periods of time (when though adiabatic conditions can be assumed) for small troughs and the error increases slightly as the trough size increases. Additionally, it has been confirmed that the trough aspect ratio does not play a significant part. It has also been corroborated, as implicitly stated in the standard, that except for cables lying on the floor (or too close to the ceiling), the position of the cables is not important. As shown in Table I, for medium and long duration times the IEC standards under-predict by as much as 15% the temperature attained by the cabled.

**Conclusion**

Through this work a physically sound model has been proposed for the thermal rating of cables installed in unfilled troughs. The adopted model is compatible with IEC standard methods since it is an equivalent circuit where all parameters can be computed from the geometrical dimensions and the physical forces (heat sources and sinks) that influence the installation. It has been shown that the intensity of solar radiation and trough and soil parameters, ignored by the IEC standard, have an important influence. The model proposed here accounts for the intensity of solar radiation as well as all of the trough and soil parameters. This work has been an important step in updating standardized methods that, in situations described above, are inaccurate and could end up leading to failures in the immense electric systems that feed large cities.

*Matthew Terraciano, Graduate Student Member completed his high school education at East Meadow High School with an advanced regents diploma in 2006. He was awarded a Bachelor of Science degree in the field of Electrical Engineering at Polytechnic Institute of NYU in 2010. He has also completed his M. Sc. Degree in electrical engineering at the same institution under the advisory of Professor Francisco De Leon. His*
research interests include cable ampacity calculation. Terraciano hopes to enroll in a PhD program at the NYU-Poly. Keep up the good work, Matthew. The world needs more good engineers.

Your Assigned a Project, What Now?

Edward B. Farkas*

As a young engineer I was tempted to join the ranks of management. My first boss, a Principal Engineer in the Engineering Department’s Design Division was willing to take a chance on a young kid. He asked me to manage a small project. Decades have passed but I still remember those times fondly. My boss and most importantly my mentor Thomas DeGenaro was a Senior IEEE Member. His boss was an IEEE Fellow, the Chief Electrical Engineer and one time Chair of the New York Section, Frank Schink! And me? I was fresh out of college and working at the Port Authority of New York and New Jersey which employed professionals that probably had forgotten more than I would ever know.

I thought: “Here is my big chance, what do I do now?”

Since then many years have passed and, eventually, I learned exactly what has to be done when you become responsible for the success or failure of a project or program. At this point I’ll share some good news and some bad news. The good news is that there are some very specific actions that can and should be taken. The bad news is that some of the actions require attention to details and lack of experience can bite you – you know where. Fortunately, common sense helps where experience lacks.

The first steps

The very first thing you should do is to identify all documents that describe and define the scope of a project or program. The documents may include specifications, drawings, contracts, legal agreements, charters and more. Make sure that you have secured them all.

Now that you have all of the scope documents you need to review them. The review has to be done in such a way that some very specific elements get identified. These elements may be included within a note on a drawing, referenced in an agreement and so on. This part of the work must be done carefully and with great attention to detail. Believe it or not, you will actually be creating foundation pieces for success. Whatever you miss is equivalent to cracks in the foundation. If you miss a big item you end up with a huge crack in the foundation.
You have to identify the following:

- Deliverables
- Risks
- Constraints
- Stakeholders
- Assumptions

Deliverables are, if you will, what your customer will be left with when the project or program is completed. A more formal definition might be the product of service that the project is creating. For example, if you are building a substation the deliverables may include but are not limited to, the circuit breakers, the fence surrounding the substation and relay test reports, etc. Bear in mind that each Deliverable has a monetary value, will require human and material resources to build or install and will require time to get done. In other words, if you miss a Deliverable it will mess up something important like your budget or schedule.

With the same level of attention you gave to the Deliverables review the documentation to glean the Risks. This is where experience counts. Sometimes, for example, the Risk is contained in how a Deliverable is defined. Here’s what we’re talking about: The specification states “...the Contractor must submit a test report of the installed high voltage cables within three business days to the Resident Engineer...” Are we talking about a continuity test, a dielectric test, or both? Does the report require signed test data or can the Contractor simply submit a letter that says “yup, looks good”. As a general rule of thumb when a Deliverable is subject to interpretation you have a risk. Another example is that the manufacturer has to provide post-installation “training.”. What kind of training? Is it virtual, class room, in the field, with materials and for how many hours, etc? Other Risks may be associated with Contractor dependencies, permits that may be required, known or unknown site conditions and more. The reason you need to focus on indentifying Risks is because if you don’t know what they are it’s literally impossible to make any plans to manage them. In other words, your efforts will be at the mercy of risks that can end up increasing costs or delaying the project.

Constraints can have financial or schedule implications and are, oftentimes, embedded in scope documents. Here’s the bad news. The only way to discover the Constraints is to pay attention to details by carefully reviewing all the documentation you got earlier. The Constraints may include time when work
can or can’t be performed, where work can or can’t be done, when phases or all of the work has to completed, lead time for materials and authorizations and limitations associated with permits.

Stakeholders are people or entities that have a vested interest in the project or program like your boss. You should know who they are. At this point you may be wondering why, after working so hard to figure out the Deliverables, identify the Risks and glean the Constraints you are now getting into figuring out who all the Stakeholders are. In the world of management there’s an old adage: You can complete your work on time, within budget and still fail. You can still fail, particularly if this is your beginning venture into management, because you did not manage the expectations of your stakeholders. Your stakeholder’s expectations may be different from what is stated in the documents. The only way to figure that out is to know who they are and talk to them. Many of the Stakeholders are indicated in the documents, others are implied, and you have to sort this out by reading the paperwork. The documents may not explicitly state every entity or person. Examples of this may be related to community approvals, permits and department heads within your company that have to review submittals.

It’s not unusual for documents, even contracts, to include Assumptions. Once, for example, (this actually happened) it was simply assumed that the location for a substation was just fine. We owned the property. There were no residential properties nearby. It seemed perfect. Turned out that there were major municipal subsurface utilities under the site, smack where the building foundation was supposed to be, and it became literally impossible to construct a structure that would house the controls. It ended up being one of the shortest projects in history. One unproven Assumption killed the project.

An efficient way to identify the Deliverables, Risks, Constraints, Stakeholders and Assumptions is by setting up a spreadsheet with a column for each and noting the location and page number of each item. It may be easier if you use different color highlighters when reviewing the documents and then transposing the results into the spreadsheet.

**What do I do now?**

It’s important to note that you have not made any decisions or had conversations where you could put your foot in your mouth. This is good for you. You are still in the process of digesting information and getting foundation data to plan out next steps.

The next action is to read available correspondence associated with the project and program. Try to get a sense of what the Stakeholders think, what has or has not been done. What goals or concerns may be out there and, importantly, how this project can be linked to the corporate or agency strategic objectives and to the requirements for achieving those objectives.

Finally, you can now leave the world of cubicles and speak to other human beings. Speak to different stakeholders and leverage their knowledge. Get their opinions and ask probing questions to further
identify potential risks, better understand Deliverables and how to best construct, install, test or main-
tain them. See if you can gauge their expectations.

At this juncture you have a good understanding of what you are supposed to manage and know the
stakeholders. A good next step is to use the data in the spreadsheet created earlier to put together a
plan.

Here we won't have the space to discuss all the details of a comprehensive plan but what we can do is
discuss some foundational components.

Start by taking the Deliverables listed in the spreadsheet and organize them in a way that seems logical.
Take, for example, a complex Deliverable and decompose it into smaller sub-Deliverables. A panel of
relays can be divided into individual relays and so on. This is sometimes referred to as a Work Break-
down Structure (WBS).

A schedule is simply a tool that tells you who does what and when. The “what” are the Deliverables.
You can extract them from the WBS to start developing a schedule. The “who” are your resources.
“When” is the timing and durations of the activities needed to produce the Deliverables. The resources
are either your fellow employees or your contractors. It’s much easier to figure out how long it takes to
install one relay than to estimate and entire panel all at once. Using bite size pieces will make schedu-
ling easier. Try to have pieces that don’t take longer than ten to fifteen days to complete.

Take the Risks and create a plan to manage them. You have already taken the first step required for any
risk management plan. You have identified them. Perhaps in other articles there will be discussions on
the remaining four steps needed to manage risks. We don’t have time to get into the details now but
those steps are: qualify, quantify, determine a strategy to manage the risk, monitor and control.

With the information you have on the Stakeholders determine how you will manage communications.
Who will receive information and at what frequency. Determine which Stakeholders should be on the
review or approval path. What meetings are needed and who should be attending. A basic plan manage-
ing communications should be documented.

Look at the Assumptions and see if they should be categorized as a Risk or if they should be taken into
account when putting together the schedule or be discussed with one or more Stakeholder.

So….now, if you are assigned a new opportunity you know what your first steps should be.
When all those important pieces are systematically put together one by one
the job will be well done well connected and duly completed. Your clients will like it

Good luck!


Saving history

The story of Edison dynamo no. 16

Robert W. Lobenstein

With introductions by Mel Olken and Carl Sulzberger

[This historical account first appeared in the IEEE Power & Energy Magazine, May/June 2012, vol. 10, No. 3 shown at left. It is being reproduced here with the kind permission of Mel Olken, LF, Editor-in-Chief of that magazine, since it could very well interest New Yorkers who do not have access to the magazine. - Editor]

An introduction to the Lobentsein account by Mel Olken as it appeared in the editorial of P&E magazine follows:

An IEEE Milestone in “History”

Our issue’s “History” column is one very close to my heart. As the historian of the New York Section, it was my privilege to be the sponsor of an IEEE Milestone event honoring the Edison Pearl Street Station, which to my amazement had never occurred given its significance. Research revealed that this had been the result of the historic site being a parking lot for many years. Working with the IEEE History Center, we concluded that Con Edison, our local utility, the direct descendent of the Edison company that built the Pearl Street Station, might be considered for the site of the milestone plaque. That provided the final impetus to proceed with the project.

It was while working on the milestone that I learned of what Robert Lobenstein (Loby) was attempting to do with an Edison 100 kW dynamo from the 1880s. The juxtaposition of these two projects seemed inevitable and fortunately my longtime friend Ronald Bozgo, who was then Con Edison VP of Engineering, was in total agreement when I approached him. And the rest is history, if I’m allowed a pun. Ron and I agreed that when Loby showed us this beautifully refurbished 120-year-old machine in June 2010, and then actually ran it, this was one of the most memorable experiences of each of our engineering careers.

I believe this column, written by Loby and superbly edited by Carl Sulzberger, will be one that our readers remember. I can report that, though the details were well known to me in advance, I thoroughly enjoyed reading the column and feeling a part of history.
PARTICIPATE IN THE IEEE MEETINGS FOR A BETTER WORLD
MINGLE WITH YOUR COLLEAGUES
LEARN AND SHARE YOUR IDEAS WITH OTHER ENGINEERS
This issue’s “History” article tells two separate but related and equally important stories. One story is that of remembering and commemorating the remarkable achievements of Thomas A. Edison. The article begins with the 10 May 2011 dedication of an IEEE Milestone honoring Edison’s pioneering Pearl Street, Manhattan, central generating station. Following the IEEE Milestone dedication, a late 19th century Edison bipolar 100-kW dynamo that once operated at Edison’s Pearl Street, Brooklyn, central generating station was also dedicated and placed on display.

The other story that this article tells is a chronicle of the almost 40-year quest of Robert W. Lobenstein, the remarkable individual who, decades ago, discovered three retired pieces of early Edison power equipment languishing in forgotten storage and who had the vision, foresight, and determination to rescue the 100-kW dynamo, a smaller 30-kW Edison dynamo, and a small rotary converter and to restore these very rare artifacts of the early years of electric power. Now on display, the two dynamos can be appreciated today and by future generations. Readers will note that much of this article is written in the first person, in the words of author Robert W. Lobenstein.

Lobenstein retired on 1 January 2010 as general superintendent of power operations for New York City Transit (NYCT) where he oversaw the operation and maintenance of the 1,100-MW subway traction power system. As a 40-year veteran of transit power operations, he continues to serve as a volunteer traction power historian for the New York Transit Museum.

Lobenstein has appeared in PBS’s American Experience and MythBusters television programs and has appeared in “Mad Electricity,” a Modern Marvels television program covering the inventions of Nicola Tesla. Lobenstein has also assisted a number of authors in their historical and technical research, including providing photographs to illustrate their works.

We are honored to welcome Robert W. Lobenstein back for his third visit as our guest history author for IEEE Power & Energy Magazine.

—Carl Sulzberger
Associate Editor, History
Robert W. Lobstein:

ON 10 MAY 2011, MEMBERS AND officers of IEEE, officials of the Consolidated Edison Company of New York (Con Edison), and friends gathered at the Con Edison Learning Center in Long Island City, New York (see Figure 1), in the shadow of the Queensboro Bridge, to dedicate an IEEE Milestone plaque. The celebration and luncheon recognized the historical significance of Thomas Edison’s first central generating plant, which began operating at 257 Pearl Street, Manhattan, in 1882 (see Figure 2).

Figure 1. Con Edison Learning Center in Long Island City, Queens, New York (photo courtesy of Virginia Sulzberger).

Figure 2. Drawing of the exterior of the 257 Pearl Street, Manhattan, generating station, circa 1882 (image courtesy of the Consolidated Edison Company of New York).
IEEE Milestone Dedication

After welcoming speeches by Ronald Bozgo, Con Edison’s vice president, central engineering, and Melvin Olken, IEEE New York Section historian and nominator of the Pearl Street IEEE Milestone, the keynote address covering the early history of the Edison system was delivered by Paul Israel, noted author, Edison scholar, and director and editor of the Thomas A. Edison Papers at Rutgers University (see Figure 3). Moshe Kam, 2011 IEEE president, spoke about IEEE Milestones in general and the importance of the Pearl Street Milestone and then invited Kevin Burke, president, chairman, and CEO of Con Edison to the podium to help unveil the Pearl Street IEEE Milestone bronze plaque. A standing ovation followed (see Figures 4 and 5).

IEEE Milestone plaques are usually affixed to buildings or locations directly related to the achievement honored. In the case of the original Pearl Street plant, after a devastating fire in 1890, the building was stabilized and temporary generators were installed. The first generation equipment in the station was quickly outdated, and the buildings at Pearl Street were closed and razed before the dawn of the 20th century.

President Burke accepted the plaque on behalf of Con Edison and thanked all attending for this distinct honor. As the 257 Pearl Street site today is nothing but an open parking lot, the decision was made to install the IEEE Milestone plaque in the lobby of the Edison Building at 4 Irving Place, Manhattan, near a bronze bust of Thomas Edison.

Burke then spoke about a little-known Edison power plant, Pearl Street in Brooklyn (yes...there were two Pearl Streets!). He informed the gathering that thanks to the rescue and restoration efforts of Robert W. Lobenstein (the author of this article), retired general superintendent of power operations for the New York City Transit (NYCT) subway system, and volunteers from the Metropolitan Transportation Authority (MTA) Pitkin Yard Electrical Motor Rewind and Fabrication Shop (Pitkin Yard), a piece of early
Edison history was saved. A bipolar Edison-Hopkinson dynamo bearing number 16 on its builder’s plate and rated at 100 kW, identical to the dynamos installed at the Manhattan Pearl Street station just a few days after the 1890 fire, is now proudly on display on the main floor of the Con Edison Learning Center (see Figure 6).

Burke presented a certificate of appreciation to the author for the intricate, historically accurate restoration of dynamo no. 16 (see Figure 7). He further invited all to go downstairs to the main floor after the ceremony to view and appreciate the fine work that was done in the restoration.

In his remarks, Lobenstein dedicated the restored dynamo to all engineers and electrical workers, past and present, and made a special dedication to the children as they will take up our mantle and become the backbone of the electrical industry in the future (see Figure 8).

After closing remarks by Ronald Bozgo, the dedication event adjourned for picture taking and a walk downstairs to see dynamo no. 16 on display in its new home.
Watching Over History

For over 38 years I’ve watched them...sitting quietly on the gutted turbine floor of the old 1905 Kent Avenue powerhouse (see Figure 9).

When the sale of our New York City subway powerhouses to ConEdison took place in 1959, the vintage 25-Hz generating equipment was gradually retired and ultimately removed from our old BMT (Brooklyn Manhattan Transit) 1905 Kent Avenue powerhouse. Until its closure in 1999, old Kent Avenue remained a switch house sending 11-kV power, generated at the remaining plants at 59th Street and 74th Street, Manhattan, to various transit substations in Brooklyn and Queens. Sometime during the 1960s, Con Edi-
son began to store old equipment on the empty turbine floor. Two of about a dozen pieces were Thomas Edison’s early bipolar “long-waisted Mary Ann” dynamos. A small unit of approximately 30 kW and a much larger one of 100 kW sat side by side in silence, barely protected with rotting tarpaulins.

I became interested in these machines in the early 1970s when our substation crews were dispatched to the powerhouse to witness hi-pot testing of our almost century-old 11-kV feeders. Each time I walked through the plant, I’d stop by and marvel at the construction of these machines. I took several photographs with a Polaroid camera and later took some 35-mm photos. The large dynamo caught my eye because affixed to it was a plate that stated that this unit was one of the Brooklyn Pearl Street dynamos, identical to the ones installed at Edison’s Manhattan Pearl Street station after the destructive fire in 1890. Old dynamo no. 16 had a great lineage, though I puzzled: “Edison had a Brooklyn Pearl Street too?”

In the latter part of the 1880s, the Edison Electric Illuminating Company (EEICo.) branched out into Brooklyn. The First District powerhouse, ironically, was located on Pearl and Adams Streets in downtown Brooklyn, near the Brooklyn and Manhattan Bridges (see Figures 10 and 11).

EEICo. Brooklyn was a holding of Kings County Electric Light and Power Company (KCEL&PCo.), which became a Brady/Murray holding and was reorganized as Brooklyn Edison Company (BECo.) in 1919. BECo. did not become part of the Consolidated group until 1943, at which time it was acquired by Con Edison.

Here the newer, more efficient technology of Edison-Hopkinson bipolar dynamos replaced the “Jumbo”
design dynamos originally installed across the river at the Pearl Street, Manhattan, station in 1882. Brooklyn is where dynamo no. 16 went into service, together with other similar machines, powering nearby Brooklyn neighborhoods until alternating current (ac) systems superseded direct current (dc) generation, transmission, and distribution. Brooklyn Pearl Street was the site of an interesting peak load dc to ac power conversion. It was initiated in the summer of 1897 and probably continued until about 1900 during each summer of the Coney Island resort season. This conversion used dc dynamos (most probably including no. 16) to power an inverted rotary converter to produce ac power. Transformers stepped up the output to permit a 12-mi (19.3-km) transmission of power to Coney Island where the voltage was stepped down and converted back to dc. This dc power was not intended to meet local needs but rather to power the amusement parks and especially the resort hotels, which constituted a substantial summer electric load. Many owners were eager to scrap or sell their isolated stations that proved to be an economic burden since they remained idle during the off season.

During the 1976 U.S. Bicentennial celebration, the New York Transit Museum, located in Brooklyn Heights, was established. By then, I had begun my efforts to squirrel away vintage power equipment for display. I also worked over the decades with our museum to give talks and tours of our old turn of the 20th century substations.

**Rescuing History**

I was always interested in power history and believed that these two early Edison dynamos stored at the Kent Avenue powerhouse should be preserved for future generations to appreciate. However, at that time I didn’t know that I would be doing the saving and restoring! I made it a point in the early 1980s to affix tags with my name and phone number to the dynamos just in the remote chance that, when the time came, I would be the one to give these historic machines a new more dignified home. As time went on, I progressed up the ladder to my position of general superintendent in transit power operations. The time had come to retire the 25-Hz feeder systems from Con Edison. I was on hand on 3 August 1999 and had the privilege of cutting out the last 11-kV, 25-Hz feeder and retiring the old Kent Avenue facility from transit service.

I immediately began making inquiries about those old dynamos. As they were considered scrap (what a Shame!), I asked if I could take the smaller unit and hoped that Con Edison would remove and preserve the large Pearl Street dynamo. We were about to take the smaller machine but discovered all power feeds to the old station crane were cut, and the only way to safely get it out was during building demolition. Even dismantled, the solid cast iron pieces were much too heavy to move by hand. I was disappointed, but I didn’t forget these machines or give up on my quest.

Fast forward to 2008, when developers were eager to get the land where the old Kent Avenue powerhouse stood. I received a call from the Con Edison demolition team. They saw the tags I had placed on those dynamos decades earlier and offered me both machines. Heavy equipment was brought in and the building walls, one by one, came tumbling down. As crews tore through the south facing wall of the turbine floor, payloaders were brought in and both dynamos and a small 25-kW rotary converter that was discovered alongside dynamo no. 16 were saved for future historical research and restoration. I was working with Gordon Lockhammer and Joe Country, two fine gentlemen from Con Edison who arranged pickup of the small dynamo and the rotary converter. The 100-kW Pearl Street machine remained on site at that time in the rear yard, its fate uncertain (see Figure 12).
I brought the two smaller machines to our Pitkin Yard shop where I began the slow process of documenting, photographing, and restoring the small 30-kW dynamo.

After approaching friends in ConEdison, IEEE, and other historians, it was decided that the 100-kW Brooklyn Pearl Street dynamo would be given to me. Our MTA crane truck couldn’t lift the machine, so Con Edison, using heavy equipment, loaded it up and delivered this historic machine to Pitkin Yard (see Figures 13–16).
Restoring and Preserving History

One thing that must be understood is that Thomas Edison knew little of eddy currents. All of his early dynamos were constructed of solid and heavy cast or wrought iron from the upper yoke to the base. While it was claimed that an over 90% efficiency rating was obtained, that level of efficiency was reached at the price of heat. That is why, after the opening of the original Pearl Street station in Manhattan, large blowers were required to cool the fields and armatures in an effort to prevent burnout.

Everything that I learned in the reconstruction of the smaller unit was applied to the 100-kW dynamo no. 16. Dismantling the small 30-kW dynamo was accomplished using our five-ton (4.54-metric ton) shop crane. The two massive bolts holding the yoke in place were removed. The bolts were stamped “Edison Machine Works,” no doubt constructed at Edison’s New York Goerck Street works. The yoke was moved to a workbench where the field connection plate and all bolts were removed. A thorough cleaning and painting was the easiest part of the restoration. All nuts and bolts were sand blasted and chased with a taps and dies for easier assembly. Utilizing the knowledge that I gained in restoring the small 30-kW dynamo, the next task was to dismantle the 100-kW dynamo no. 16 (see Figures 17 and 18). Almost every early dynamo had a plate on top holding a carbon filament lamp to indicate machine output. Outlines of such plates were discovered on the yokes. Replicas were fabricated at the shop using gray insulating fiberglass, looking much like the original marble connection plates. Brass sockets from the turn of the 20th century were affixed. I have several century-old glass-tipped carbon filament bulbs in storage, and one of these was installed on each of the completed machines.
The bearing caps were removed to reveal perfectly preserved babbit bearings and oil rings. The two outer rings pick up oil and direct it to the bearing surface, and the circular brass bearing mount perfectly centers both sides of the bearing on the armature shaft (see Figure 19).

With a little cleaning of the bearings, the armature was free to turn. We used to use what was called “dynamo oil” in our large subway generators and rotary converters, but after we ceased rotary operations in 1999, there was none to be had. A substitute of 30-weight motor oil will suffice for the time being. Figure 20 shows an antique dynamo oil can that I donated to the New York Transit Museum.

![Figure 19. Perfectly preserved babbit bearing on the armature shaft of dynamo no. 16 (photo courtesy of Robert Lobenstein).](image1)

![Figure 20. Dynamo oil can used in New York City Transit substations and powerhouses, circa 1900 (photo courtesy of Robert Lobenstein).](image2)

Kent Avenue facility, thieves broke in and tried stealing anything of value such as copper builder’s plates, lugs, and bus work. Dynamo no. 16 even had its brush boxes stolen. The leads to the bipolar field wiring were found cut also. Working carefully, each cut end of the old field was spliced into new number nine motor wire. The splices were carefully insulated and imbedded back into the windings, while the new leads were directed outward to the yoke above. Each was checked for continuity and grounds and, to my surprise, after almost 130 years, the original coils were clear of short circuits and grounds. The early dynamos, after assembly, had their vertical field poles wrapped with a protective rope winding. The 100-kW dynamo no. 16 still had its severely deteriorated wrapping, so a sample was taken and matched. Three 600-ft (183-m) spools of 0.250-in (6.4-mm) manila rope were purchased, and several days of careful wrapping ensued. The final outcome was impressive, as these dynamos seemed to take on a new life of their own (see Figure 21).
While field wrapping was underway, copper leaf brushes were made to replace the carbon brushes found retrofitted in the brush holders of the smaller dynamo. Before I started up the smaller machine for a test, I reinstalled the carbon brushes to determine the final rotation and then permanently installed the copper leaves as was done in Edison’s day.

Using pictures from similar machines and photos that I had taken years ago, new brush arms were constructed for dynamo no. 16. Six copper leaf brush holders from one of our dismantled 1899 transit rotary converters were installed. However, we fitted the large unit with carbon brushes for the test run. Figure 22 shows the dynamo no. 16 lower base, reconstructed brush holders, and armature, which has been painted with black Glyptal insulating varnish. Also shown is the unpainted zinc magnetic break between the bipolar field and the base.
Making the New Look Old Again

After I was satisfied that the field was intact and the red fiber field coil insulators were cleaned and repainted, the crane picked up the yoke and reunited it with dynamo no. 16. Now it was on to final assembly before painting.

Only three original copper field lugs remained, and each was stamped with an “F#” to identify the connections. Having only modern pretinned copper lugs, I matched the size and then hand stamped, like the originals, each one with its new field position identification. A trip to the sand blaster stripped off the tin, and after the squared edges were rounded, the new lugs looked like the 1880s originals.

Thanks to the old Polaroid pictures I took 30 years ago, I was able to reform the field wires into their original positions on the terminal blocks. One by one, the lugs were soldered onto the leads, leaving a nice old patina on the lugs. Using historically accurate materials like friction tape, the leads were carefully taped and bolted onto their final positions (see Figure 23).

For historical reference, the old field leads on the smaller dynamo, which were not destroyed by thieves, were found with the original insulating tape on them. I left the original tape in place so that one can see how these machines were constructed so many years ago.

Once the bipolar fields for dynamo no. 16 were complete, the base and armature and the fields were reassembled. The five-ton (4.54-metric ton) crane strained under the load, but as each piece was installed, the dynamo took on a new life (see Figure 24).

Copper bus work that leads from the lower armature brush connections to the upper yoke terminal blocks was formed and installed (see Figure 25). Everyone in the shop was anxious to do a full test run to hear what these dynamos would have sounded like when running.
A Great Dynamo, but a Miserable Motor

Thomas Edison and his fellow “wizards” at the Menlo Park laboratory developed this type of dynamo design back in the late 1870s. It was a marvel of engineering as it turned mechanical energy into a somewhat stable source of dc. When supplied with power from a dc source, the dynamo would run as a dc shunt motor, a very bad shunt motor that spits and sparks. Edison took one of the smaller dynamos, turned it on its side, and installed it within a frame. Wooden insulated railway wheels were attached, and Edison had one of his first electrically powered trains traveling around his Menlo Park complex. He built two of these locomotives while he was busy constructing his 1882 Pearl Street plant in Manhattan. Work on the electric engines was stopped for others like Frank Sprague, his assistant, to pick up where Edison left off. The two locomotive frames can be seen today in the front yard of Edison’s West Orange, New Jersey, laboratory and factory complex, now a part of the Thomas Edison National Historical Park.

It’s Alive, It’s Alive!

The paint was dry and all connections were sound. It’s now time to see if these dynamos would spin. The smaller dynamo was first. Using a 17-V, 2,000-W resistor in series with the field circuit, 125-V dc from a spare substation lead-acid battery was applied. Using a compass, I verified that the north-south field was correct. A 4.5-V resistor in series with the armature circuit was energized. With video cameras rolling and with a little help, I spun the armature shaft and the 30-kW dynamo awoke from its century-long sleep. A quick check of the bearings showed that the oil rings were spinning and lubricating the bearings.

Changing the resistance of the field and armature, the machine was up to speed spinning almost silently. The repair section personnel erupted with cheers and applause! A few adjustments of the brushes to find the neutral plane to reduce sparking and the small dynamo was complete. A few weeks later, when the large 100-kW Brooklyn Pearl Street dynamo no. 16 was completely assembled, we gathered once more to give it a spin. Using the same resistors in the field and armature, the power was turned on. Again, with a little prodding, the armature started to roll and built up speed. Another round of cheers and applause by all assembled must have sounded like the day Thomas Edison fired up the original dynamos at Pearl Street. Many were in awe to see such a sight. A piece of history, our history, restored and brought back to life (see Figure 26).
A New Respectful Home

The smaller dynamo was moved to our New York Transit Museum and put on display in our new electrical exhibit in late October 2011 where visitors will be able to see the connection between this machine and Edison’s early efforts in electric railroading.

As our transit rotary converters are much too large for the New York Transit Museum displays, the small 25-kW rotary converter will be restored some time in the future and placed on display to represent its much larger 1,000–4,000-kW cousins.

The completely restored Brooklyn Pearl Street dynamo no. 16 proved to be too heavy for our transit trucks to transport. Con Edison’s master rigger, Kevin McGuire and crew, using a 30-ton (27.2-metric ton) crane and flatbed truck, came to Pitkin Yard and picked it up like a toy (see Figure 27).
Its permanent place of honor is on the main floor of the Con Edison Learning Center, giving all employees and visitors a historic view of electrical machinery that first lit up New York City. This will serve as a proud reminder to all that our modern extensive generation, transmission, and distribution systems had their humble beginnings with these machines (see Figure 28).

Members of IEEE and Con Edison joined me to inspect the dynamo restoration work, and all were very pleased with and impressed by the historic display. To top off the restoration, Con Edison’s shop in Westchester cast a replacement builder’s plate from photos that I furnished. Old Edison dynamo no. 16 is finally home (see Figure 29).

**Acknowledgment**

I wish to thank all of the volunteers at the MTA NYCT Pitkin Yard power repair shop who assisted me in these restoration projects. A job well done!
A journey through Galapagos islands

Lewis Terman*

Where are Galapagos Islands?

At the end of last April, we went on an 8 day National Geographic tour to Galapagos Islands. We first flew to Guayaquil, Ecuador, where tour members stayed overnight, and then took a 1 1/2 hour flight to the Islands and boarded our ship, the National Geographic Islander.

The Islander is a relatively small ship, with a capacity for 48 people in 24 cabins; National Geographic also has a larger ship, the Endeavor, which is twice as large; we opted for the smaller group. The food, accommodations, public areas, and staff and guides were excellent. Access to the Islands is closely controlled by the Ecuador government, and the schedule of islands visited by each tour is pre-set for that tour. We were told that all visitors must come as part of a tour. The number of islands is too large to see everything on one trip, but there is so much to see that no one felt shortchanged.

Our group was quite varied, intelligent and very interesting, without any bad eggs. There was a small concentration of people from the Atlanta area, but otherwise the homes of the tour members were
pretty well spread across the US. It was a great trip, and we saw flora and fauna which can be found nowhere else in the world. The animals seemed to be totally unafraid of humans, and you could walk right up to them.

In Galapagos the individual groups are limited to 16 people plus a naturalist, to ensure the animals are not overwhelmed by too many people at one time. In addition to visiting the various islands, we had numerous opportunities for such activities as swimming, kayaking, and snorkeling. Late April/early May is a good time to visit Galapagos, as it is the mating season for birds and they constantly fill the sky, and the water is warmer than later in the year. That is also the end of the rainy season which is good for visitors, because the rainy season has short showers followed by clear periods, while the "dry season," we were told, can have relatively long misty periods. We were fortunate in having good weather throughout, except for a very short period of light precipitation while we were going over lava - but lava, while it is has very good traction to shoes when dry, becomes astonishingly slippery even with a small amount of precipitation. The weather was hot, and some hikes were a bit of a challenge when there was no breeze, but generally acceptable.

A fascinating and distinctive place to visit. Highly recommended!!

A few of the photographs taken by the author have been posted in this issue of the Monitor. You can access all of them in a pdf format by clicking on the appropriate button on the anchor page.

*Dr. Lewis Terman, IEEE Life Fellow and 2008 president of the IEEE, is also an IBM Research Emeritus. He is still heavily involved with IEEE through conferences, committees and the Awards Board, but still finds time to indulge in traveling!"
Do you ever get the urge to walk or sit in a quiet place looking at the verdant terrain that surrounds you? Do you like sculptures? Can you stay without munching food or gulping down soda? If the answers to these questions are yes then I can suggest a place near New York City where you find them all. It is serene and beautiful and so near to the city. Depending where you live in the City it is within 30 to 40 miles. I measured the distance from my home in Jamaica Estates in Queens it clocked up exactly 28 miles.

This serene place is known as Donald M. Kendall Sculpture Gardens after Mr. Kendall, the former chairman and CEO of PepsiCo who conceived it. The visitors’ handout states: “He (Mr. Kendall) imagined an atmosphere of stability, creativity and experimentation . . .” He started collecting the sculptures placed all over the gardens in 1965 and today the collection has 46 twentieth-century sculptures in the 152 acres of beautifully tended landscape.

Yes, there is also a building inside the gardens. It is the world HQ of PepsiCo. The building was designed by Edward Durrell Stone. The land (now the gardens) on which it stands was a polo field. The landscaping was finished by E. D. Stone, Jr., the son of the architect.
Russel Page, the famous garden designer in 1980 began to extend the gardens. Now “it incorporates new features and, by careful planting, relate the sculptures to their immediate surroundings.” Page also created the Golden Path that winds through the area. The course of the meandering path is shown on the map, the second slide in the album on the gardens. In 1985 the internationally famous garden designer François Goffinet joined the team and the garden is now an oasis away from the hustle and bustle of a big city. Oh, I forgot to mention that the gardens have two lakes. One of them is huge. The other is not so big but as beautiful. You will be able to discern them on the photos.

Believe it or not, the entire garden has no kiosk where you can buy food or drinks. Only a small hut that is called the visitors’ information center has a small automat which dispenses bottles of Pepsi. This center also houses the restrooms. Additionally, you can get a descriptive brochure that has the map of the gardens on which the sculptures are clearly marked. When you enter the gardens from the visitors’ center you will see wooden tables and benches on the right. You can use them for resting or eating (if you happen to have food with you). The parking areas are vast. The gardens are open every day of the week. A maintenance man told me that during on a weekday some 200 - 500 visitors enter the gardens. During the weekends that number swells to 1,000 – 2,000.


It was my fourth visit to the Sculpture Gardens and, surely, will not be my last. To paraphrase one commercial in the TV: “I guarantee that you will like it.”

**Internationally famous sculptors whose fruits of labor are displayed in the sculpture gardens**

(in alphabetical order of first names)


Aristide Maillol: *Marie*: December 8, 1861 – September 27, 1944: French (Catalan)

Arnaldo Pomodoro: *Grande Disco*: b. June 23, 1926: Italian

Arnaldo Pomodoro: *Triad*: b. June 23, 1926: Italian

Art Price: *Birds of Welcome*: No data available

Asmundur Sveinsson: *Through the Sound Barrier*: 20 May 1893 – 9 December 1982: Icelandic

Auguste Rodin: *Eve*: November 12, 1840 – November 17, 1917: French

Barbara Hepworth: *Family of Man*: January 10, 1903 – May 20, 1975: British

Barbara Hepworth: *Meridian*: January 10, 1903 – May 20, 1975: British

Bret Price: *Big Scoop*: birthday not available: American

David Smith: Cube Totem Seven and Six: March 9, 1906 – May 23, 1965: American

David Wynne: Dancer with a Bird: b. 1926: British

David Wynne: Girl with a Dolphin: b. 1926: British

David Wynne: Grizzly Bear: b. 1926: British

George Rickey: Double L Excentric Gyratory II: June 6, 1907 – June 17, 2002: American

George Segal: Three People on Four Benches: November 26, 1924 – June 9, 2000: American

Gidon Graetz: Composition in Stainless Steel No. 1: b. in 1929 in Haifa, Israel


Henry Moore: Double Oval: July 30, 1898 – August 31, 1986: British

Henry Moore: Locking Piece: July 30, 1898 – August 31, 1986: British

Henry Moore: Sheep Piece: July 30, 1898 – August 31, 1986: British


Jean Dubuffet: Kiosque l’evide: July 31, 1901 – May 12, 1985: French


Kenneth Snelson: Mozart I: b. June 29, 1927: American


Louis Nevelson: Celebration II: 23 August, 1899 – 17 April, 1988: American (born in Russia)

Max Ernst: Capricorn: April 2, 1891 – April 1, 1976: German

Richard Erdman: Passage: b. June 1, 1925: American


Robert Davidson: Totems: b. November 4, 1946: Canadian


Tony Smith: Duck: September 23, 1912 – December 26, 1980: American

Wendy Taylor: Jester: No data available

William Crovello: Katana: b. 1929, New York City
Disclaimer: This piece of travel guide is solely written for people who like nature and would like to get away from the city once in a while. I am not an employee of PepsiCo and have no business interest in that company. Its mention is merely coincidental, since the company owns the property.

Sculpture in Lincoln Center (behind Hearst Plaza)

Review

Bodymedia

Health management on your armband

Amitava Dutta-Roy

BodyMediaFit

Once upon a time not so long ago I used to jog every day. Now I walk, some 4 miles at a stretch and four times a week. I have been looking for a pedometer quite some time that would give me an idea of how many steps I walk and for how far. I discovered after purchasing several of them from the usual retail stores that the inexpensive ones (± $20) are no good. It is not easy to calibrate them and they break very easily. Last year I joined a group of walkers in Cunningham Park, Queens and after attending the walking
sessions for four consecutive weeks I was given a free pedometer, thanks to the Parks and Recreation Department of the New York City mayor’s office. But that also went kaputt. They are so flimsy.

One day I descended on Paragon, the famous store for sporting goods near Union Square. They had an electronic pedometer for $40 but I was not convinced that it would perform all of the duties its brochure boasted. Then a friend introduced me to a gadget known as BodyMediaFit. It is an interesting device meant not only for health freaks but also for any person (really!). It is much more expensive but its literature states that it would give you the measurements that could, in theory at least, could improve your physical performance. I decided to give it a try. I am still learning about all the tricks the gadget can show. Hence, the following is my first attempt to inform you about the product. Only you can decide if it is good for you.

The basic device consists of a 1.5” x 1.75” x 0.25” plastic pad, known as the Core (shown above left), that has two metallic sensors (shown at right), a press-switch to turn the device on or off, and a hidden USB port for connecting it to a computer. The slightly curved pad has two slits and an armband (left) goes through them and the device can be worn on the arm, like a blood pressure monitor complete with Velcro fasteners, the two metallic sensors touching the skin. The grey band is 1.25in wide and about 14” in circumference. (If you are very muscular and the circumference of your arm is more than 14,” I suppose, you are out of luck.) Only when the band is loosened and then the device detached from its tiny plastic frame-like holder the USB port reveals itself (left). The rechargeable battery inside the device can be charged from the computer power through the USB cable.

The sensors can measure various body parameters such as skin temperature, rate of sweating and heat dissipated from your body, all in real time. In a way the BodyMedia works like a holistic probe assembly sensing some of the most important body parameters whether you are either exercising or resting. But you must wear the armband during all this time. The sensed data are recorded by the device and when it is connected to a computer they are sent to BodyMedia company for crunching them and sending back vital information on your health. It must be remembered that BodyMedia is not a stand-alone device.

Before you start using the Core the battery must be charged. That’s an easy job. While the battery is being charged a tiny orange LED light starts flashing. Once the device is completely charged and ready for use the light changes to steady green. Also, when you press the tiny switch to turn on the device you can see the steady green light.

As I have mentioned above the BodyMedia is not a stand-alone device. It only measures the vital body signals and stores them. The actual mastication of the data is done by the BodyMedia.

BodyMedia not only senses the vital signal not only when you are active but during your sleep as well. It may at least give an indication if you have sleep disorders that many do not even know and that has become a cause for concern. Apparently, 23 million Americans have this problem.
The Core costs $149. To set up the device and sync it with the BodyMedia engine somewhere in the cloud you have to sign up through www.Bodymedia.com. The subscription for the first three months is free. For subsequent use a charge of $6.95 a month is levied. However, that entitles you to all kinds of information not only about yourself but also the calories of your favorite foods. See below for samples of information you could get on your computer screen.

Once you sign up you can enter your height, weight and age etc. and customize the system to work for you. You can set your goal of losing (say) 2lbs a week. The Bodymedia system will calculate how much calorie a day you must lose and advise you on the food that would give adequate results. The diagnostics of your bodily functions are shown in a dashboard fashion. They are clear to read.

BodyMedia also sells a display panel like a wristwatch. The panel and the Core communicate via BlueTooth so that at any instant you know your activity level. But being old-fashioned (and stingy) I have not opted for the extra gizmo. For me the computer display is good enough. I am at the keyboard more than eight hours a day. So, another extra 5 minutes to check the state of my health is not a big deal.

Some readers might think that it is too much of a price to pay for a health gadget. But I tell my friends that it is their health they can keep an eye on. If it helps them to keep away from the medics, why shouldn’t they use it?

![Activity Manager](http://activitymanager.bodymedia.com:8080/subject/dp/getgraph?subjectId=987567a59869a5c2d943a79a48e190cf&format=json&formatVersion=1&userId=8675)

The displays (above and below) show calories consumed, calorie balance, physical activity and steps taken
Other displays also show calorie consumption. The wealth of information on the user's health that the little gadget provides is overwhelming and takes time to get used to.

The above is not a paid review. The author is not an employee of BodyMedia and has no vested business interest in that company.
ConEdison where many of our members worked
(and many still work) was a patron of the Holiday Festival

Photo: Amitava Dutta-Roy
Have a wonderful

4th of July

This is the end of the June 2012 edition of the NY Monitor

Thank you for visiting us!!