STEM Society Meeting, December 8, 2015

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1 About the STEM Society and the STEM Society Website

STEM is an abbreviation for Science, Technology, Engineering and Mathematics. The acronym STEM is commonly associated with K-12 education, but our use of the term is only slightly bound to this meaning. There are

over one hundred people on the mailing list, although a much smaller group attends any one meeting. We meet on the second Tuesday of each month at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The meetings are open to all. The start time is 6PM. We make presentations, have discussions, and have demonstration experiments. These relate to Science, the History of Science, Mathematics, Engineering, Philosophy and Technology at all levels. The topics have ranged from a technical discussion of the Mathematics of General Relativity to scientific experiments for young students.

These meeting notes contain links to many other documents, which may be viewed or downloaded by clicking the link. A partial list of documents can be reached by clicking the heading **Documents**. The meeting notes may also be viewed in an archive file (archive.pdf), which is in the list of documents. Many of the documents are PDF files. They may be viewed or downloaded to the computer by clicking, provided Adobe Reader, or another program capable of reading PDF files, is present. There are many more documents available at the site than are listed under **Documents** because the documents.htm file is not at all up to date. The last time I checked, about March 2014, there were about 350 document files on the site. We are in the process of creating better techniques for finding documents and authors. The first meeting of the STEM Society was in November of 2006. For several years we used the content management program called Joomla. It had a fancy looking interface, but was hard to use. It overran the space somehow at our internet provider Bluehost. So we now have a very simple HTML site. It is not so slick looking as Joomla, but is very easy to maintain and modify.

The web site is:

`http://www.stem2.org/`

Direct to the documents list:

`http://www.stem2.org/je/documents.htm`

Direct to the archive file:

`http://www.stem2.org/je/archive.pdf`

2 The December Meeting Announcement

The December meeting of the STEM Society will take place on the second Tuesday of the month, December 8, 2015, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.
Questions, Topics and possible Discussions:

(a) The life of Paul Dirac, the relation to other Physicists, and his work.

(b) Which very famous Physicist attempted murder on a second?

(c) Physics demonstration experiments.

(d) Historical adventures in Arithmetic.

(e) Where was the second communist revolution, and how did this affect Physics?

(f) Should politicians be forced to prove their skill in proving theorems and doing experiments, like Benjamin Franklin and James Garfield did?

(g) Why does everyone hate Mathematics? Is it genetic?

(h) An outline of how to make pictures of manifolds, and maps.

(i) As always, attendees are free to bring, and should bring additional topics, things, ideas, and presentations. We need more presentations from our very diverse and experienced fellowship.

3 Physics Experiment Demonstrations

We viewed a DVD of experiments from Clint Sprott of the University of Wisconsin Physics department, "The Wonders of Physics." Professor Sprott presented these demonstrations for many years.

4 Tom Grant: An Introduction to Nuclear Reactor Engineering

- OKLO Gabon, the story of missing Plutonium, which proved to be caused by a natural event in geological history.
- Potassium 40 exposure caused by sleeping with partners.
- Plutonium 238 a safe nuclear source for powering space ships and probes.

5 Dirac Biography

We briefly discussed the Dirac biography "The Strangest Man ..."

- Oppenheimer tries to poison Blackett.
- Bela Kun and the second communist revolution in 1919 occurring in Hungary.

We shall probably discuss Dirac further. For the details of my review see:

`http://www.stem2.org/je/dirac.pdf`

6 Discussion: Why Does Everyone Hate Mathematics?

Some opinions:

- Mathematics is hard, and too hard for those not interested in "knowing" and its pleasures. These utilitarians having vague goals, involving future money, fame, and worldly pleasures, do not see how Mathematics fits into these goals. Most humans realize that there are others who know much more than they do, but most throughout their lives believe, whether they are five or fifty, that they already know, pretty much, what is important, and believe that what others know, which they don't, is trivial, just part of the useless medieval trivium, and not

really the real meat of useful information. Some teachers will try to convince students that for a good job and future wealth, a subject like Mathematics is extremely important. True for some, but a major fib for others. Love what you do, and do what you love, even though life might prove unkind.

- Students say they will never use it, so why should they study it? This, is a small world view, lacking imagination. Anne of Green Gables would not have made such a remark!

- Much teaching of elementary Mathematics, including elementary Algebra, is often very repetitive drudgery (Many use the word "Mathematics" for what used to be called "Arithmetic." This use, is somewhat like referring to "spelling" as "literature"). Some say this learning failure is caused by poor Mathematics teachers. However, one guy said that there are actually some very good teachers of Mathematics in the public schools, and he has run into several, and mentioned one in particular. Teachers are blamed far too much in the failures of education. Even if you are the absolute greatest teacher, teaching your dog Calculus is probably doomed to failure from the very beginning. Don't misunderstand me, I don't consider people dogs, and I have nothing against dogs either, they are very loyal. But learning in general does require very hard work, and hard work by definition, can not be made "fun" as many like to believe; ask the coal miners. But from the hard learning comes the joy of accomplishment and the satisfaction of "knowing." Not all will ultimately feel this joy even after very hard work. Most, no matter how hard they work at it, will ever become great and joyful ballet dancers, and even those who do will likely end up with very very painful feet and joints. Those that failed at ballet might say, "Serves them right!"

- A substantial portion of the population believes that anything worth knowing is contained in the Bible, a second large portion believes that anything worth knowing is contained in Sports Illustrated. If they continue their education long enough, they may realize that they were mistaken in this belief.

  Because there is little Mathematics in either of these publications, a large proportion of the population hates wasting hard time on what they consider an irrelevant subject.

- Is mathematical skill genetic? Who knows? In my opinion, we rather overdue this gene stuff. After all according to current thought these genes just fabricate a rather small number of proteins, which do the real work of building the machine, which then to a large part, through living and experience, programs itself.

- One thing that teachers should repeat over and over to their students is that, although teachers are very helpful guides and task masters, learning is more the responsibility of the student than the teacher, because the brain belongs to the student. So if now behind, the student can catch up by reading books, working problems, and even perhaps by writing books, and please visit your local library often. School is only a start to lifetime learning. If you are having trouble with Mathematics, it is likely that you have not mastered the prerequisites (or perhaps you are not in love, and perhaps not yet reached puberty). So backup and study the prerequisite Mathematics. But even if you only partially understand the current Mathematics, plough ahead a bit to get an indication of the character of the future battle, so that you can polish and sharpen the needed weapons, and acquire the appropriate protective clothing.

7 Historical Adventures in Arithmetic: Casting Out Nines

What is the number 352648 mod(9) (that is, what is the remainder upon division by 9)? If a number is divisible by 9, then the number mod 9 is zero, because the remainder is zero. For the same reason if $n = n_1 + n_2$ and n_2 is dividable by 9, then

$$n \text{mod } 9 = n_1 \text{mod } 9.$$

We have

$$352648 = 3(100000) + 5(10000) + 2(1000) + 6(100) + 4(10) + 8.$$

So we can rewrite it as

$$(352648 = 3(99999+1)+5(9999+1)+2(999+1)+6(99+1)+4(9+1)+8) \text{mod } 9$$

$$= (3+5+2+6+4+8+(3*99999+5*9999+2*999+6*99+4*9)) \text{mod } 9$$

$$= ((3+5+2)+6+4+8)\text{mod } 9$$
$$= (1+6+4+8)\text{mod } 9$$
$$= ((1+6+4)+8)\text{mod } 9$$
$$= (2+8)\text{mod } 9$$
$$= ((2+8))\text{mod } 9$$
$$= 1\text{mod } 9$$

Indeed

$$352648 - 9 * 39183 = 1$$

Proposition. If n is an integer, then

$$n \bmod 9 = s \bmod 9,$$

where s is the sum of the digits of n.

So as in the previous example if $n = 352648$, then the sum of the digits is $3+5+2+6+4+8$, and you can evaluate this mod 9 by adding digits from the left until the sum exceeds 9, then subtract 9 and keep the remainder, (that is cast out nines), and continue in this way to the end of the summing.

If an arithmetical calculation is correct in ordinary arithmetic, then it is correct mod 9 also, which by the above procedure is simple and can be done in your head. This can be used to check calculations. This was taught in the schools back when calculations were done by hand, rather than by machines (adding machines, cash registers, or computers). I suppose this could be done very rapidly with the skill that comes with practice. So if you were calculating a product of two large numbers, you could replace the two large numbers by their mod 9 values, multiply then together, mod 9, and check for agreement with the mod 9 value of the product.

8 Lehrer on Lobachevski

Tom Lehrer is a song writer, singer, and mathematician. He was very popular in the 50's and 60's among the intelligentsia and among lovers of political satire.

Professor William Ashworth of UMKC and the Linda Hall Library is a Science Historian. Recently he sent out a document to his subscribers about Lobachevskey and the song about Lobachevski written by Lehrer.

Lobachevskey is a Mathematician famous for creating a Non-Euclidean Geometry, which satisfies all the postulates of Euclid's Geometry except the parallel postulate. The famous parallel postulate of Euclid states: *One and only one parallel line to a given line may be constructed through a point not on the original line.* The philosopher Immanuel Kant proclaimed that Euclidean Geometry is the only possible geometry. Lobachevskey disagreed. In his geometry many parallel lines to a given straight line may be constructed. In another geometry no parallel exists at all: Straight lines are geodesics, the shortest paths. On a sphere geodesics are great circles, which all intersect each other, therefore there are no pairs of parallel lines. Sorry Immanuel Kant, rational philosophy has some problems, doesn't it?.

`http://www.youtube.com/watch?v=IL4vWJbwmqM`

Tom Lehrer - Lobachevsky Lyrics

For many years now, Mr. Danny Kaye, who has been my particular idol since childbirth, has been doing a routine about the great Russian director Stanislavsky and the secret of success in the acting profession. And I thought it would be interesting to st... to adapt this idea to the field of Mathematics. I always like to make explicit the fact that before I went off not too long ago to fight in the trenches, I was a mathematician by profession. I don't like people to get the idea that I have to do this for a living. I mean, it isn't as though I had to do this, you know, I could be making, oh, 3000 dollars a year just teaching.

Be that as it may, some of you may have had occasion to run into mathematicians and to wonder therefore how they got that way, and here, in partial explanation perhaps, is the story of the great Russian mathematician Nicolai Ivanovich Lobachevsky.*

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Who made me the genius I am today,
The mathematician that others all quote?
Who's the professor that made me that way,
The greatest that ever got chalk on his coat?

One man deserves the credit,
One man deserves the blame,
and Nicolai Ivanovich Lobachevsky is his name. Oy!
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Nicolai Ivanovich Lobache...

I am never forget the day I first meet the great Lobachevsky.
In one word he told me secret of success in Mathematics: Plagiarize!

Plagiarize,
Let no one else's work evade your eyes,
Remember why the good Lord made your eyes,
So don't shade your eyes,
But plagiarize, plagiarize, plagiarize...
Only be sure always to call it please, "research".

And ever since I meet this man my life is not the same,
And Nicolai Ivanovich Lobachevsky is his name. Oy!
Nicolai Ivanovich Lobache...

I am never forget the day I am given first original paper to write. It
was on Analytic and Algebraic Topology of Locally Euclidean Metrization
of Infinitely Differentiable Riemannian Manifold.
Bozhe moi!
This I know from nothing.**
But I think of great Lobachevsky and I get idea - haha!

I have a friend in Minsk,
Who has a friend in Pinsk,
Whose friend in Omsk
Has friend in Tomsk
With friend in Akmolinsk.
His friend in Alexandrovsk
Has friend in Petropavlovsk,
Whose friend somehow
Is solving now
The problem in Dnepropetrovsk.

And when his work is done -
Haha! - begins the fun.
From Dnepropetrovsk
To Petropavlovsk,
By way of Iliysk,
And Novorossiysk,
To Alexandrovsk to Akmolinsk
To Tomsk to Omsk
To Pinsk to Minsk
To me the news will run,
Yes, to me the news will run!

And then I write
By morning, night,
And afternoon,
And pretty soon
My name in Dnepropetrovsk is cursed,
When he finds out I published first!

And who made me a big success
And brought me wealth and fame?
Nicolai Ivanovich Lobachevsky is his name. Oy!
Nicolai Ivanovich Lobache...

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I am never forget the day my first book is published.
Every chapter I stole from somewhere else.
Index I copy from old Vladivostok telephone directory.
This book, this book was sensational!***
Pravda - ah, Pravda - Pravda said:
"Jeel beel kara ogoday blyum blocha jeli," ("It stinks").
But Izvestia! Izvestia said:
"Jai, do gudoo sun sai pere shcum," ("It stinks").
Metro-Goldwyn-Moskva bought the movie rights for six million rubles,
Changing title to 'The Eternal Triangle',
With Brigitte Bardot playing part of hypotenuse.****

And who deserves the credit?
And who deserves the blame?
Nicolai Ivanovich Lobachevsky is his name.
Oy!
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9 Books

[1] Dieudonné Jean, **History of Functional Analysis**, North-Holland, 1981, (LHL QA320.D4 1981).

[2] Dieudonné Jean, **A History of Algebraic and Differential Topology, 1900-1960**, Birkhäuser, 1989 (LHL QA612.D54).

[3] Dirac Paul .A .M, **The Principles of Quantum Mechanics**, 4th Edition, 1957 edition, reprinted 1993, Oxford University Press.

[4] Farmelo, Graham, **The Strangest Man: the Hidden Life of Paul Dirac, Mystic of the Atom**, 092715 kcmo, LHL Books (QC16.D57 F37 2009)

[5] Sprott Clint, **Physics Demonstrations**, University of Wisconsen Press, 2006, Linda Hall Library, QC33 .567, (**The Wonders of Physics**, Videos on 2 DVD's).

[6] Wigner Eugene p., **Symmetries and Reflections: scientific essays**, 1979, Oxbow Press, (contains essay: The Unreasonable Effectiveness of Mathematics).