STEM Society Meeting, April 14, 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 April Meeting Announcement

The April meeting of the STEM Society will take place on the second Tuesday of the month, April 14, 2015, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.
Possible Topics:

(a) An experiment in producing a technical book on the Espresso Book Machine at the Mid-Continent Public Library.

(b) A wood joining project with compound angles using elementary Vector Analysis.

(c) Creating figures for scientific documents using Postscript.

(d) A possible talk by Dave Van Dyne on a the Discrete Element Method applied to material flow.

(e) A discussion on the advantage, if any, of a liberal education over a scientific education, based on a current book in the news.

(f) If time permits other topics in Mathematics, Physics, or Engineering.

(g) Surprise extemporaneous talks, projects, "show and tell," are encouraged.

3   Dave VanDyne: The Discrete Element Method (DEM) Applied to Chute Flows

Dave VanDyne works for the Beumer Group, a world-wide company based in Germany.

`http://www.beumergroup.com`

Dave gave a demonstration of the simulation program called **Bulk Flow Analyst**.

This program is a product of the company called **Applied DEM**. Material particles are modeled as spheres with various forces acting between the particles. In this demonstration the flow of material is simulated moving on conveyer belts and down various chutes. The belts can be miles long and can cost millions of dollars each. So any failure can be very expensive. Dave ran the actual program in real time on his laptop. We found this to be quite interesting and impressive.

Email from Dave about his proposed talk:

From: David Van Dyne, Apr 10 at 10:18 PM

To: jim emery

Hi Jim,

I will try to have a few minutes of "show and tell" results on some DEM (discrete element method) simulations of chute flows that I have been working on. I have not had the time to put together any sort of a discussion of the theory behind this. I would like to present some of my results, however.

See you Tuesday, 5:30 p.m.

4 Jim Emery: How to Make a Book

Jim Emery described an experiment creating a book on the Espresso Book Machine located at the Woodneath Library Center located near Liberty Missouri. This is a branch library of the MidContinent system. It gets its name from a building near the library called the Woodneath Mansion, which is now part of the library. This was a first test and the book by Jim Emery succesfully created is called **Optics**. Only a few words were presented at the meeting. We shall no doubt return to this topic.

See the document called **How to Make a Book**:

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

5 Jim Emery: Making Arrows and Vectors With Postscript, Infix, Prefix, Postfix and RPN

6 Jim Emery: Vector Analysis Applied to Carpentry

See the document

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http://www.stem2.org/je/molding.pdf
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7 Rick Hines: The Creation of Elaborate Octagonal Stairs

Rick created these stairs in his very interesting very large house, which he designed and built himself. The railings for the stairs were a particularly hard design problem. After a carpenter he hired failed repeatedly in trying to cut joints for these railings, (using up much valuable wood in the process), Rick brought this problem to Bob Williams. This was many years ago. Bob was able to show that the joints with just two rails meeting were actually impossible. Rick realizing this, was able to create a new design using a small third block as part of the joint. Rick used drawing techniques from his old knowledge of descriptive geometry and engineering drawing. He brought several large rolled up drawings giving his analysis and solution. He also presented pictures of the completed staircase. We had a discussion of the powerful techniques of descriptive geometry, which were used to create and engineer the complex buildings, machines, airplanes, etc, that produced the industrial revolution before the age of computers.

8 Creating a Postscript Figure

Here is the program that was used to create the figure in the document with the file name **molding.pdf**:

```
c     moldingf1.ftn figure for crownmolding.tex 4/13/15
```

```
      implicit real*8(a-h,o-z)
       dimension p1(3),p2(3), v1(2),v2(2),v3(2),v4(2)
       dimension q1(3),q2(3),q3(3),q4(3),q5(3)
       dimension t1(2),t2(2),t3(2),t4(2),t5(2),t6(2)
       nfile=1
       open(nfile,file='p.eg',status='unknown')
       one=1.
       pi=4.*atan(one)
       vxmn=-1.
       vxmx=1.
       vymn=-1.
       vymx=1.
       call xvwpor(nfile,vxmn,vxmx,vymn,vymx)
       xmn=-4.
       xmx=4.
       ymn=-4.
       ymx=4.
       call xwindo(nfile,xmn,xmx,ymn,ymx)
       size = xmx-xmn
       if(ymx-ymn .gt. size)size=ymx-ymn
       phi=60.*pi/180
       theta=45.*pi/180
c      draw corner
       a=2.
       b=a*tan(theta)
c      b/c=tan(phi)
       c=b/tan(phi)
       p1(1)=0.
       p1(2)=c
       p1(3)=-a
       p2(1)=b
       p2(2)=0.
       p2(3)=0.

        if(1+1 .eq. 2)then
c fill large face of board in top view
       t1(1)=0.
    t1(2)=3.*c
```

```
t2(1)=0.
t2(2)=c
t3(1)=b
t3(2)=0.
t4(1)=b
t4(2)=3.*c
t5(1)=t4(1)+ .5
t5(2)=t4(2)
t6(1)=t3(1)+.5
t6(2)=t3(2)-.5*tan(pi/6.)
call xmove(nfile,t1(1),t1(2))
    call xdraw(nfile,t2(1),t2(2))
    call xdraw(nfile,t3(1),t3(2))
    call xdraw(nfile,t4(1),t4(2))
    call xdraw(nfile,t1(1),t1(2))
write(nfile,'(a)')'p gsave'
    write(nfile,'(a)')'p .5 1 1 setrgbcolor'
    write(nfile,'(a)')'p fill'
    write(nfile,'(a)')'p grestore'
    write(nfile,'(a)')'p stroke'

call xmove(nfile,t4(1),t4(2))
call xdraw(nfile,t5(1),t5(2))
call xdraw(nfile,t6(1),t6(2))
call xdraw(nfile,t3(1),t3(2))
call xdraw(nfile,t4(1),t4(2))

write(nfile,'(a)')'p gsave'
    write(nfile,'(a)')'p .5 1 1 setrgbcolor'
    write(nfile,'(a)')'p fill'
    write(nfile,'(a)')'p grestore'
    write(nfile,'(a)')'p stroke'




endif
```

```
c       draw vector from p2 to p1 in top view
        call xmove(nfile,p2(1),p2(2))
     call xdraw(nfile, p1(1),p1(2))

       v1(1)=0.
       v1(2)=1.
       v1(3)=0.




c      draw top view

c      draw left board edge
        x=0.
    y=c
    call xmove(nfile,x,y)
    x=0.
    y=3*c
        call xdraw(nfile,x,y)
c draw small coordinate axis
        x=0.
    y=0.
    call xmove(nfile,x,y)
        x=b
        call xdraw(nfile,x,y)
        x=0.
    y=0.
    call xmove(nfile,x,y)
        y=c
        call xdraw(nfile,x,y)

c      draw right board edge
        x=b
    y=0.
    call xmove(nfile,x,y)
    x=b
    y=3.*c
```

```fortran
      call xdraw(nfile,x,y)

c         draw left pointing edge of corner
          y=c
      x=0
      call xmove(nfile,x,y)
      x=-2.*c*cos(30.*pi/180.)
      y= c -2.*c*sin(30.*pi/180.)
          call xdraw(nfile,x,y)
c


      h=.003*size

c         draw vector v1
      x1=b
          y1=0.
      alen=.5
      call drawvector2d(nfile,x1,y1,pi/2.,alen,h)

c         draw vector v2
      x=p2(1)
          y=p2(2)
c
      do i=1,2
       v2(i)=p1(i)-p2(i)
      end do
      write(*,*)' v2= ',v2(1),v2(2)
      v2n=sqrt(v2(1)**2+ v2(2)**2)
      write(*,*)' length=',v2n
      do i=1,2
       v2(i)=v2(i)/v2n
      enddo
      write(*,*)' v2= ',v2(1),v2(2)
      angv2=atan2(v2(2),v2(1))
c     angv2=atan2(1d0,-1d0)
      write(*,*)' ang=',angv2*180./pi
      alen=.5
```

```fortran
      call drawvector2d(nfile,x,y,angv2,alen,h)
c
c         draw vector v4, normal to cut face
          x=(p1(1)+p2(1))/2
          y=(p1(2)+p2(2))/2
          ang= -120.*pi/180
          alen=.5
           call drawvector2d(nfile,x,y,ang,alen,h)

c         draw front view
c         origin point
c         zoffset of view
          zoff=1.
          q1(1)=0.
          q1(3)=0.-zoff
          write(*,*)' q1=',q1(1),q1(3)
          call xmove(nfile,q1(1),q1(3))
          q2(1)=b
          q2(3)=0.-zoff
          write(*,*)' q2=',q2(1),q2(3)
          call xdraw(nfile,q2(1),q2(3))
          q3(1)=0.
          q3(3)=-a -zoff
          write(*,*)' q3=',q3(1),q3(3)
          call xdraw(nfile,q3(1),q3(3))
          call xdraw(nfile,q1(1),q1(3))
c
          call xmove(nfile,q2(1),q2(3))
          q4(1)=q2(1)+ .5
          q4(3)=q2(3)
          write(*,*)' q4=',q4(1),q4(3)
          call xdraw(nfile,q4(1),q4(3))
          q5(1)=q3(1)
          q5(3)=q3(3)-.5
          write(*,*)' q5=',q5(1),q5(3)
          call xdraw(nfile,q5(1),q5(3))
          call xdraw(nfile,q3(1),q3(3))
c
```

```
            write(nfile,'(a)')')'p stroke'
c       fill board in front view
     write(nfile,'(a)')')'p newpath'
           call xmove(nfile,q2(1),q2(3) )
           call xdraw(nfile,q4(1),q4(3) )
           call xdraw(nfile,q5(1),q5(3) )
           call xdraw(nfile,q3(1),q3(3) )
           call xdraw(nfile,q2(1),q2(3) )
     write(nfile,'(a)')')'p gsave'
           write(nfile,'(a)')')'p .5 1 1 setrgbcolor'
           write(nfile,'(a)')')'p fill'
     write(nfile,'(a)')')'p stroke'
           write(nfile,'(a)')')'p grestore'
           x=(q2(1)+q3(1))/2.
           y=(q2(3)+q3(3))/2.
           alen=.5
           ang=135.*pi/180.
     call drawvector2d(nfile,x,y,ang,alen,h)
     h=.002*size
     x=0.
     y=0.
     ang=pi/2.
     alen=1/3.
     call drawvector2d(nfile,x,y,ang,alen,h)
     ang=0.
     alen=1/3.
     call drawvector2d(nfile,x,y,ang,alen,h)
     y=0.-zoff
     ang=pi/2.
     call drawvector2d(nfile,x,y,ang,alen,h)
     ang=0.
     call drawvector2d(nfile,x,y,ang,alen,h)
           end
c+ drawvector2d
           subroutine drawvector2d(nfile,x1,y1,ang,an,h)
           implicit real*8(a-h,o-z)
           dimension u(2),v(2)
           x2=x1+an*cos(ang)
```

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```fortran
      y2=y1+an*sin(ang)
      call drawarrow(nfile,x1,y1,x2,y2,h)
      return
      end
c
c+ drawarrow create arrow outline and postscript fill
      subroutine drawarrow(nfile,x1,y1,x2,y2,h)
      implicit real*8(a-h,o-z)
      dimension u(2),v(2)
      dimension p1(2),p2(2),p3(2),p4(2)
      dimension p5(2),p6(2),p7(2),p8(2)
      write(nfile,'(a)')')'p gsave'
      write(nfile,'(a)')')'p newpath'
c     x1,y1  coordinates of arrow tail
c     x2,y2  coordinates of arrow point
c     h      1/2 arrow shaft width
c     ahw      arrow head width
      ahw=4*h
c     ahl      arrow head length
      ahl=8*h
        theta = atan2(y2-y1,x2-x1)
   u(1)= cos(theta)
   u(2)= sin(theta)
   v(1) = -sin(theta)
   v(2)= cos(theta)
c       alen arrow length
        alen=sqrt((x2-x1)**2 + (y2-y1)**2 )
        p1(1)=x1
        p1(2)=y1
   p2(1)=p1(1)+ h*v(1)
   p2(2)=p1(2)+ h*v(2)
   p3(1)=p2(1)+(alen-ahl)*u(1)
        p3(2)=p2(2)+(alen-ahl)*u(2)
   p4(1)=p3(1)+ 2*h*v(1)
   p4(2)=p3(2)+ 2*h*v(2)
   p5(1)=x2
   p5(2)=y2
   p8(1)=p1(1)- h*v(1)
```

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```
p8(2)=p1(2)- h*v(2)
p7(1)=p8(1)+ (alen-ahl)*u(1)
p7(2)=p8(2)+ (alen-ahl)*u(2)
p6(1)=p7(1) - 2*h*v(1)
p6(2)=p7(2) - 2*h*v(2)
     call xmove(nfile,p1(1),p1(2))
     call xdraw(nfile,p2(1),p2(2))
     call xdraw(nfile,p3(1),p3(2))
     call xdraw(nfile,p4(1),p4(2))
     call xdraw(nfile,p5(1),p5(2))
     call xdraw(nfile,p6(1),p6(2))
     call xdraw(nfile,p7(1),p7(2))
     call xdraw(nfile,p8(1),p8(2))
     call xdraw(nfile,p1(1),p1(2))

     write(nfile,'(a)')'p 0 0 0 setrgbcolor'
     write(nfile,'(a)')'p fill'
     write(nfile,'(a)')'p stroke'
     write(nfile,'(a)')'p grestore'
   end
```

9 The Liberal Arts: Quadrium, Trivium, and the Dangerous STEM

The concept of Liberal Arts comes from ancient Greece and its democracy and freedom (with slavery for the non-citizens). The Greeks believed that in order for a liberal or free democracy to work the citizens must be educated and know certain "free" or "liberal" arts. The uneducated mob could not be trusted to rule.

The Seven Liberal Arts were divided into the Trivium ("the three roads") and the Quadrivium ("the four roads").

The Trivium consisted of three subjects, which more or less were the language arts, Grammar, Rhetoric, and Logic, that is writing, speaking, and logical arguing. The Quadrivium consisted of mostly mathematics, and the deductive aspects of ancient science: Arithmetic, Geometry, Music, and As-

tronomy or Cosmology. The medieval Quadrivium thus followed the division of mathematics made by the Pythagoreans. Music was considered largely mathematical involving the numerical ratios of strings on stringed instruments. Science, that is knowledge by experiment, had no high status in ancient times. The word **trivial** comes from the Trivium, essentially consisting of subjects from grade school, whereas the Quadrium is more from high school.

Fareed Zakaria wrote an editorial for the Washington Post this spring titled **Why Americas obsession with STEM education is dangerous,** which has sparked much discussion. This calls up the old debate of the humanities versus the sciences. Of source the ancient Quadrium is largely Science. This was a topic for our meeting which was only brought up briefly. Zakeria has also written a book titled **In Defense of a Liberal Education.**

People like **Zakeria**, are largely arguing from ignorance, they knowing very little about the great bulk of all human knowledge, namely, modern **Science** and **Mathematics**. Many in the practical arts, of course, do not know much about the specialized people areas of history and literature, which however really makes up only a small part of current knowledge, and which frequently almost seems like small time village gossip. This latter knowledge is important for party chat and communication. I must confess however, that I have always had a large interest in these small time historical and literary areas, but I don't know why really? But knowing the history of culture and of ideas is very helpful in understanding the contemporary world, and in getting on. According to the Americans of a commercial bent, one must chat-up people before one can pick their pockets.