Impact of WWI on people, skills, infrastructure, culture, international cooperation in a teachable century.

Physics
Chemistry
Astronomy

IUPAP
IAU Div. C
Aug 2015
ACS SF
Aug 2014
IAU
Heidelberg
Mar 2015
APS Baltimore
Apr
A SORT OF OUTLINE

How I came to the subject
WIMPI-creep; shelves full of Nature (and not much else),
with first examined issue about imprisonment of German
eclipse expedition in Crimea (August 1914)

What else were people doing in 1914?
Caruso (signing autographs), C.B. De Mille (1st Hollywood
feature (The Squaw Man), and
NAACP founded, first US Mothers' Day, first CRC handbook,
1st major league game in Wrigley Field (Chicago Federals
defeated Kansas City Packers, 9:1), Dylan Thomas born
Ludlow Massacre (Colorado coal strike), ASCAP founded,
1st Chaplin film & 1st "Tramp" film, Holst Planets,
Joe Hill arrested, start of Shackleton expedition,
1st Rose Bowl game, Milankovich cycles, Picasso's "Guitar"
Max von Laue's Nobel for X-ray crystallography,
Panama Canal opened, Federal Trade Commission,
Clayton Anti-trust Act, Marines occupy Veracruz,
UK foreign secr. says he has never seen Eur. so peaceful

Add your own favorites

Status of chem, phys, astr in 1914; BASI 49, 465-486
Papers per Year in J. Chem Soc, London

VT 1934 PASP 46, 1807

Post War Explosion

Depression

WW I

WW II
First full-length feature shot in LA by Lasky Feature Play Co. 1914
The Squaw Man
Gen. Manager Samuel Goldfish, starred Dustin Farnum
"SHAKING HANDS WITH SHAKESPEARE"

Sir William H. McCrea: "When I was very young, I met an elderly member of the Sædewick family who had known someone who had known someone who had known Newton."

VT: Moseley in one, via the younger Bragg
   Emmy Noether in one, via Olga Tauskey Todd

Our Nobelists reach all earlier Nobel winners (not Tomonaga!) via a few steps in the Swedish Royal line.

At Kyoto & Haige IAUs, you may have met Japanese & Dutch royalties (though 1988 was opened by the mayor of Baltimore).

What interesting chains do you belong to?

NOW ask students to interview oldest member of family (who is still compositus) and trace their chains

Families of recent immigrants might reach Ho Chi Minh, Mao Tse Tung (mé only via Nixon), Porfirio Diaz etc., perhaps also science lines in other countries.

Ask them what language(s) might they need to know to communicate along their chains.

NOW go back in your own life and trace some non-science chains.

Various possible individual & class projects; unexpected chain intersections (I met Igor Stravinsky; anybody else?)
SIMULTANEOUS EVENTS IN
Science (both) Society

1908
K Schwarzschild
vel. ellipsoid
Haber fixes N
Austria annexes Bosnia &
Herzegovina from Ott.
Empire (B&H object)

1914
Shapley to Mt. W.
Slipher 40 S V's
at AAS
Freundlich
eclipse exp. in
captured in Crimea
French use tear
gas on W front

Franklin-Adams
plates published
Hitler volunteers to
Kapteyn star stream
Bavarian army,
velocities; considers absorption
serves as dispatch
Wolf RAS Gold medal
runner

Cepheids in M31
Louvain U library
& NGC 6822 EPH
burned

This can be done for just about any year 1908-1923, but
really hard to space columns, so rest have sci & soc
separated
SCIENCE

1909 SS not at MW center, Bohlin, gl. cls. on sky

1910 RAS Gold to Sir David Gill (so hem work)

1911 Rutherford atom

1912 Leavitt Ceph. P-L, Slipher first Gal. Vr (M31)

1913 Hertzsprung calibrates Ceph P-L, Moseley first atomic weight paper; 1917 Barkla Nobel should have been his
A note on Nobels - given almost continuously 1908-39, and
not MUCH discrimination between winners & losers of WWI
A note on RAS Gold Medals, also given continuously, but after
Max Wolf summer 1914, next real German is Unsold in 1957
(though Michelson 23 & Einstein 26, both German-born Jews)

1914 also Schuster-Schwarzschild (K.) approx.

1915 AEinstein completes GR (note: he had urged the 1914
Grimea expedition to look for pre-GR light bending)
Moseley killed at Gallipoli (also Bragg's other son)

1916 K. Schwarzschild papers on GR metric, ballistics & dies,
Van Maanen thinks S's rotate in plane of sky

1917 Hubble defends PhD and volunteers
1917 Curtis & Crommelin support Island Universes, de Sitter solution, Einstein static univ

1918 Shapley's giant Milky Way, SS not at center, Weyl U. Oberth's broth killed, Schroedinger U with vacuum E Kulik brings back sample of Tver meteorite

1916(oops) P Kempf measure solar rotation from Potsdam (flocculi)
Nature continues to report German comet, variable star, etc results coming via Copenhagen Eddington Standard Model; receives news of GR from de Sitter)

1919 Hubble to Mt W; Solar eclipse expedition finds light bent Shapley opposes external galaxies, Perrir (telesite meter) says stars live on fusion
IAU Founded in Brussels (last Solar Union was Bonn 1913) Jeans's U is $10^{12}$ yr old

1920 Kapteyn Universe (d. 1922), Eddington says stars live on subatomic energy (radioactivity as E source had already turned up at discussion before Kelvin's death)

1921 Curti-Shapley Debate; 1922 Friedmann soln, Opik d to M31 Kulik to Tunguska
SOME ODD NOBEL PRIZES IN PERIOD

1908  Physics, Lippman, color photography from interference
1910  Peace, Permanent International Peace Bureau
1914-16  Peace - none
1917  Peace - International Red Cross
1919  Peace - Woodrow Wilson
1913  Peace, Lafontaine Pres of Perm Int. Peace Bureau
1920  Peace - Bourgeois, drafter of framework for League of Nations
1922  Peace - Nansen of passports (M Schwarzschild fellowship)
1925  Peace - Austen Chamberlain, Locarno Pact,
       Charles Dawes mitigated German reparations
1939-43  no prizes; 1944 Red Cross again
1912  Physics - Dalen (SW) regulator for lighthouses
1920  Physics - Guillaume, anomalies in nickel steel alloys
1926  Perrin (yeah, same guy) sedimentation equilibrium
SOCIETY/INTERNATIONAL ETC IN PERIOD

1908 First Model T Ford; Taft elected
1909 Peary * Hansen (black) reach N Pole
Young Turks revolution
1910 Death of Edward VII, Bwoegra V (cousin of both
Czar Nicholas II and Kaiser Wilhelm II) becomes king
1911 Turkish-Italian War, first military offensive use of
aircraft; Italy takes Liby & Tripoli
Sun Yat Sen becomes Pres. of Chiha; Madera of Mexico
Churchill First Lord ofthe Admiralty
1912 Wilson elected; first Balkan War
1913 Last time Wm. II, George V, and Nicholas II together
(wedding of WM II's daughter to Duke of Brunswick)
Rite of Spring; Armory Show
FDR Asst. Sec. of Navy
1914 Lemaitre and R. Minkowski both on active duty (W and E
fronts, and for the duration). Belgian colleagues
say Lemaitre had intended priesthood before War
(Schroedinger on Italian-Austrian front later)
1915 Hitler receives his first Iron Cross 2nd class
Germans use chlorine at Ypres, April (their 4th try
at gas; advice from Haber) Phosgene in December
Anthony Eden (of bombing of Suez Canal while PM) serves
1915 Lusitania sunk with American aboard (no whole weapons, but pieces) in sight of coast; rescues botched
1916 Wilson re-elected; First US congresswoman
Battles of Verdun & Somme
Blackett & future George VI at Jutland
1917 Russia out; US in; Balfour Declaration (Chaim Weizmann)
Geo. V refuses asylum to Nich. II & family
Germany uses mustard gas
1918 Hitler awarded Iron Cross First Class (Wallerstein's uncle's story).
Wm. II abdicates; Nich. II shot
US making phosgene, chloropicrin & mustard gas
Gas responsible for 1.32% of battle deaths (larger fraction of injuries; Hitler probably gassed)
Poland resuscitated; Armistice 11/11
Spanish flu begins killing 20,000,000 or so vs 9M war
1919 Treaty of Versailles forbids poisonous liquids & gases in German (and MUCH else); Weimbar Constitution
Allied gas attacks on Soviet Russia
Gandhi begins satya graha
1920 Treaty of Trianon Hungarian Borders; Harding elected
First League of Nations meeting, KDKA licensed
Estonia independent; Iraq Br. mandate
First transcontinental airmail
1919  Treaty of St. Germain sets borders of Austria
1921  Washington conference forbids gas in war (indeed little in WWII)
      German runaway inflation; Reza Kahn to power in Iran
1922  German-Russian Treaty of Rapallo
      Japan leaves Vladivostok; Ireland independent
      Ataturk overthrows Sultan; Mussolini takes Rome
      Washington Naval Treaty limits sizes of ships; guns;
      Lexington becomes aircraft carrier
1923  France & Belgium occupy Ruhr to collect reparations
      Treaty of Lausanne draws Turkish borders
      Palestine becomes British mandates; lots of Japanese
      mandates over former German islands (Syria & Lebanon
      French mandates
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Winston: Cumulative
Ency. 1914 83 elements

Missing: Ho Hf Tc Pm
U Th Ra decay products

Sorting of R.E._ Mosley +
1913-14 ff.

Gallipoli 1915
### Met. Beob. an der k. k. Sternwarte in Krakau
in Monate August 1914.

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### Windverteilung

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<td>45</td>
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Maximum der Windgeschwindigkeit: 27 Kilometer in der Stunde am 5. zwischen 8°-9° a. m. bei N.
Niederschlagsbäue: in 186 m, Höhe 55-61 mm, in 0-7 m, Höhe 62-99 mm.

1) Schwarzkugelthermometer im Vakuum.
You can get a great reputation for wisdom just by telling people what they already know.
A THREE-DIMENSIONAL GRID OF IMPACTS

X axis: Time frame: before, during, after

Y axis: Disciplines: chemistry, astronomy, physics, other

Z axis: Entities affected: individual people
          groups of people
          international structures (etc.)
          physical infrastructure
          skills & products
          scale-ups
          Central Powers vs. Allies vs. neutrals
          national organizations etc.

That is, a 3X4X7 (or more) data cube

none of the 84 boxes empty, some fuller than others

Famous scientists who served & survived very numerous; those
who died less numerous (age effect, but Moseley & K.
Schwarzschild)
ABOUT POISON GASES (Cl, mustard gas, \( \text{C}_4\text{H}_8\text{Cl}_2\text{S} = \))
dichlorethyl sulfide, \( \text{²} \) tear gas

about 90,000 deaths out of 9 million

22/4/15 German Cl at Ypres (town)
22/9/15 British Cl at Loos

July-Nov German mustard gas at Passchendaele(village) 1917

Rutherford never forgave Haber

Further development led to gases used in WWII camps
Violation of Hague Convention removed barriers (US
defoliants in Vietnam and all)

Definitely not decisive in the war nor in many battles
compared to barbed wire and tanks

Others: phosgene (\( \text{COCl}_2 \)), chloropicrin (\( \text{CCl}_3\text{NO}_2 \)), compounds
of Br, As, CN, "Lewisite"

Capt AT Mahan had objected in 1899 at Hague to banning gases
(UK ditto)
Early gas masks, here worn by Russian officers.
From "America's Munitions"

THE CHLORPICRIN PLANT AT THE EDGEWOOD ARSENAL.

From these stills, filled with a mixture of bleaching powder, lime, and picric acid, the poisonous gas, chloropicrin, distills off. This plant produced 31 tons in one day.
‘The Greatest Catastrophe the World Has Seen’

R. J. W. Evans

John Singer Sargent: Gassed, 1919
BOX: CHEMISTRY - DURING

Central Powers
N fixation
   (Haber, arcs...)
synthetic rubber (gas masks)
synthetic fuels

Allies
optical glass (affected
   Lick, Mt. W etc)
dyestuffs (uniforms)
potash (fert. Germany)
Urey toluene for TNT

BOX: ASTRONOMY - AFTER

Demise of Hale's International Solar Union (at 1910 meeting
   K. Schwarzschild suggested future = all of astronomy)
Near-terminal slowing of Carte du Ciel (many Germ. zones)
Astrophotography: war-driven (aerial reconnaissance) dicyanin-
   sensitized plates for red and near IR
Shift of power to US (observatories at good sites, but also
   loss of people & facilities in Europe)

BOX: PHYSICS -- DURING

Work on general relativity, early quantum mechanics chugged
   along among those too old/wrong natinality to serve
The Genealogical Tree of Nitric Acid

From W. G. Whitman’s “The Story of Nitrates in the War;”
General Science Quarterly
NITROGEN FIXATION

\[ \text{N}_2 + \text{O}_2 \rightarrow 2 \text{ NO} + \text{atm O} \rightarrow 2\text{NO}_2 \text{ (arc)} \]
(lightning, Schonherr process, Birkeland-Eyde, Pauling)

\[ \text{H}_2 + 3\text{H}_2 \rightarrow 2 \text{NH}_3 \text{ (Haber)} \]
(U)

\[ \text{NH}_3 + 20_2 \rightarrow \text{HNO}_3 + \text{H}_2\text{O} \text{ (Ostwald)} \]
(Pt)

\[ \text{CaC}_3 + \text{N}_2 \rightarrow \text{CaCN}_2 + \text{C} \text{ (Cyanamid)} \]

\[ \text{CaCN}_2 + 3 \text{H}_2\text{O} \rightarrow \text{CaCO}_3 + 2\text{NH}_3 \text{ and others} \]

Postwar, German chemical patents to Allied Property Custodian (also Jahsberichte) to Chemical Foundation (4500)
BURNING AIR IN A BIRKELAND-UYDE FURNACE AT THE DU PONT PLANT

An electric arc consuming about 4000 horse-power of energy is passing between the U-shaped electrodes which are made of copper tube cooled by an internal current of water. On the sides of the chamber are seen the openings through which the air passes impinging directly on both sides of the surface of the disk of flame. This flame is approximately seven feet in diameter and appears to be continuous although an alternating current of fifty cycles a second is used. The electric arc is spread into this disk flame by the repellent power of an electro-magnet the pointed pole of which is seen at the bottom of the picture. Under this intense heat a part of the nitrogen and oxygen of the air combine to form oxides of nitrogen which when dissolved in water form the nitric acid used in explosives.
A BATTERY OF BIRKELAND-EYDE FURNACES FOR THE FIXATION OF NITROGEN AT THE DU PONT PLANT

Courtesy of E. I. du Pont de Nemours Co.
World production and consumption of fixed inorganic nitrogen expressed in tons nitrogen

IT'S AMAZING
HOW MUCH RESEARCH
HAS GONE INTO MAKING

SOME OF THE
WORST
DECISIONS.
<table>
<thead>
<tr>
<th>Source</th>
<th>1916 Tons K₂O</th>
<th>1917 Tons K₂O</th>
<th>1916 Per cent. of total production</th>
<th>1917 Per cent. of total production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral sources:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural brines</td>
<td>3,994</td>
<td>20,652</td>
<td>41.1</td>
<td>63.4</td>
</tr>
<tr>
<td>Alunite</td>
<td>1,880</td>
<td>2,402</td>
<td>19.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Dust from cement mills</td>
<td></td>
<td>1,621</td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>Dust from blast furnaces</td>
<td></td>
<td>185</td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>Organic Sources:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelp</td>
<td>1,556</td>
<td>3,752</td>
<td>16.0</td>
<td>10.9</td>
</tr>
<tr>
<td>Molasses residue from distillers</td>
<td>1,845</td>
<td>2,846</td>
<td>19.0</td>
<td>8.3</td>
</tr>
<tr>
<td>Wood ashes</td>
<td>412</td>
<td>621</td>
<td>4.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Waste liquors from beet-sugar refineries</td>
<td>63</td>
<td>369</td>
<td>.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Miscellaneous industrial wastes</td>
<td></td>
<td>305</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>9,720</td>
<td>32,573</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>


This table shows how inadequate was the reaction of the United States to the war demand for potassium salts. The minimum yearly requirements of the United States are estimated to be 250,000 tons of potash.

What happened to potash when the war broke out. This diagram from the Journal of Industrial and Engineering Chemistry of July, 1917, shows how the supply of potassium muriate from Germany was shut off in 1914 and how its price rose.
PRODUCTS DERIVED FROM COAL

COAL
- GAS
  - Gasoline
  - Tar
  - Coal
- GAS LIQUOR
  - Methanol
  - Ethanol
  - Propane
  - Butane
  - Tar
- COKE
  - Coke
  - Tar

TAR
- LIGHT OIL
  - Kerosene
  - Diesel
  - Gasoline
  - Tar
- MIDDLE OIL
  - Tar
  - Coal
  - Tar
- HEAVY OIL
  - Tar
  - Coal
  - Tar
- REFINED TAR
  - Tar
  - Coal
  - Tar
- PITCH
  - Tar
  - Coal
  - Tar

PREPARED BY
The Sheet Company
123 Main Street
New York, NY 10001
Copyright 2018
Released 2018-03-15
A molecule of a coal-tar dye

What goes into rubber and what is made out of it

Courtesy of the "India Rubber World."
PRODUCTS AND USES OF COTTONSEED

Baiting
Wadding

Stuffing material for:
- Pads
- Cushions
- Comforts
- Horse Collars
- Mattresses
- Upholstery

Linters
(23 pounds)
- Absorbent cotton
- Mixing with shoddy
- Mixing with wool in hat making
- Mixing with lamb's wool for underwear
- Felt

Low-grade yarns
- Twine
- Rope
- Carpets
- Smokeless powder

Cottonseed
(1 ton)
- Cellulose
- Writing paper
- Nitrocellulose
- Pyroxylin
- Varnishes
- Coating for metals
- Artificial leather
- Waterproofing
- Plastics
- Celluloid
- Collodion
- Varnishes
- Artificial silk
- Photographic films

Hulls
(800 pounds)
- Feed
- Fertilizer
- Fuel
- Packing
- Household utensils
- Bran—Cattle feed

Fiber
- Stuffing for horse collars
- Basis for explosives
- Cellulose
- Pressed paper products
PRODUCTS AND USES OF COTTONSEED—Continued

Cottonseed (1,200 pounds)
- Meats (1 ton)
- Cake and Meal (900 pounds)
  - Fertilizer
  - Dyestuffs
  - Feed
  - Flour

Prime summer yellow oil
- Refined oil
- Crude oil (300 pounds)
  - Putty
  - Washing powder
  - Black grease
  - Feet
  - Soap

Off-grade summer yellow oil
- Glycerin—Nitroglycerin

Cosmetics
- Animal compound lard
- Bleached oil
- Cooking oil
- Salad oil
- Hydrogenated oil—Synthetic stearin—compound lard

Cold pressed oil
- Winter oil
- Setting olives
- Packing sardines
- Winter white oil

Emulsion for medical purposes
- Stearin—Oleomargarine

Substitute for sweet oil
- Deodorized oil
- Soap
- Miners’ oil
- Hydrogenated oil—Soap

Stearic acid—Candles
- Candle pitch
- Washing powder
- Soap

Distilled fat acids
- Stearin pitch

Fat acids

Roofing tar
- Linoleums
- Insulating
- Oilcloth
- Waterproofing
- Cheap paint base
- Artificial leather

Oleic acid
- Soap
- Washing powder
- Fulling ware
How the sugar beet has gained enormously in sugar content under chemical control
PRE-GREAT WAR INTERNATIONAL COOPERATION

Gesellschaft Katalog, 1868
Cartedu Ciel 1887 (like League of Nations, US kept out)
Int. Assoc. for Geodesy 1896
Int. Union for Co-operation in Solar Research 1904

Not just astronomy
Pois et Measure in Paris
several international health organizations & standards from 1890s

International fairs & expositions
International conferences 1900-13
  New York - 14, Oslo - 15 etc.
International art exhibits, music festivals
International Sanitary Convention 1892
International List of Causes of Death 1893
Group photograph of the fifth and last Conference of the International Solar Union, held at Bonn from July 30 to August 5, 1913. It was the last fully international astronomical meeting before the First World War caused the chasm between the astronomers from the "Allied" and "Central" Powers. When this photograph was taken, the Executive Committee of the Solar Union consisted of A. Schuster, G.E. Hale, and K. Schwarzschild. The latter died during the war. The Solar Union ceased to exist a the war when Schuster and Hale decided to abolish it because its activities were taken over by the IAU. Among the participants in the left hand part of the photograph we note, seated in the front row, 6th from the left, F.W. Dyson and to his left B. Baillaud. In the right hand photograph, seated in the front row, 5th from the left W.W. Campbell, and to his left at the end of the row (probably) A.S. Eddington. All four of these would later become a President of the IAU. A list of the participants is given in Trans. Int. Solar Union, Vol. IV, p. 6, 1914.

(Collection Utrecht)
AN ASTRONOMICAL HISTORY OF THE GREAT WAR TO END ALL WARS

Beginning: 21 August 1914 eclipse, Erwin Freundlich led an expedition from Berlin to observe eclipse from the Crimea and look for bending of light (at the 1/2 of GR value then proposed by Einstein). Captured, interned with all members; equipment never recovered. Other German expeditions retreated from Kiev, observed from Finland etc, but not bending of light.

End: 191 (a) UK eclipse expedition to Sobral & Principe under Eddington & Dyson (AR) found the bending. Einstein was then perceived as a "German physicist"
(b) Founding of the IAU in Brussels (after preliminary meetings in Paris & London fall 1918
28 July; de l'Heure to live in Paris, Telegrams in Copenhagen, officers & 32 standing committees (some of which continued right down to 2015, when all abolished)

Last fully international pre-war meeting 1913 July 30, Bonn, International Solar Union (exec comm A Schuster, Hale, K. Schwarzschild)
AUGUST 1914
Eclipse Expedition
Crimea

ЭДДИНГТОН Артур Стэнли
(28.XII 1882—22.XI 1944)
1919 Eclipse Expedition

ВОЛЬФ Макс
(21.VI 1863—3.X 1932)
Dry plates
blinking comparator etc.
NAS Gold Medal 1919
(Einstein 1926)
WHO WAS WHO

"Central Powers"
Germany & Colonies
Austria Hungary
Ottoman Empire
Bosnia
Bulgaria

"Allied States"
Belgium
France & Colonies
UK + Ireland & Colonies
Japan
Brazil
Italy
Portugal
Russia
Rumania
Serbia
Greece
Montenegro
Albania
Italy
Mexico

Poland in abeyance

USA late
null
Nach Mitteilungen der Astr. Nachr. sind auf dem Felde der Ehre geblihen:

Dr. Julius Liebmann, weiß Obervor der Königlichen Sternwarte Neubabelsberg bei Berlin, getallen am 22. August in Belgien.


Dr. Martin Matzdorf, weiß Hilfsarbeiter an der Universität-Sternwarte zu Straßburg, als Kriegstreibenliger in einem Infanterie-Regiment bei einem Sturmmangriff vor Ypern am 2. November getallen.

Ehre Ihrem Andenken!

Sirius 1915. Heft 3.
Astronomen im Kriege.

Nach Mitteilungen der »Astr. Nachr.« sind auf dem Felde der Ehre geblieben:

Dr. Julius Liebmann, weil. Observator der Königlichen Sternwarte Neubabelsberg bei Berlin, gefallen am 22. August in Belgien.


Ehre ihrem Andenken!

Sirius 1915. Heft 3.


Außerdem ist der Schriftleitung noch von verschiedenen Astronomen bekannt, daß sie zur Zeit im besonderen Dienst des Vaterlandes stehen. Aus naheliegenden Gründen können aber keine Mitteilungen darüber gemacht werden, wie denn überhaupt diese Zusammenstellung den sehr berechtigten Wunsch des Leserkreises, über die Beziehungen unserer Wissenschaft zum Kriege unterrichtet zu werden, nur unvollkommen erfüllen kann.
IN BETWEEN, AND "WHATEVER BECAME OF..."

People who served, details of a few
Deaths of Henry Moseley (Gallipoli, atomic number more
fundamental than atomic weight)
Karl Schwarzschild (pemphigus, home from Russian front;
Sch. solution, criterion.....)

August Kuhl's memoire
N. Bobrovnikoff (1896-1988) to White Army, to Cyprus to
Charles U, to Chicago to Berkeley to Perkins Obs, retired to
Berkeley, saw Halley twice
S. Gaposchkin (1889-1984) Galician front to White Army to
Berlin (PhD 1933) to Harvard, married Cecilia Payne 1934
R. Minkowski (1895-1976) Russian front to Berlin, Breslau,
Göttingen, Hamburg (1922-35) to Mt. W./Palomar (largest
redshift to date on his last observing night) to Berkeley

Battle of Jutland to unheeded Churchill
advisor, advocating tanks & submarines over nuclear bombs
Frendlich, Einstein Tower 1918-33, to Turkey to Charles U to
St. Andrews, some students survive; resigned 1959, returned
to Germany (1885-1964)

Thought: Those who survived were clearly tough and long lived!
August 10, 1915: Henry G.J. Moseley Killed in Action

Science students everywhere are familiar with the modern periodic table, which organizes the chemical elements based on their properties and atomic numbers. Earlier versions, however, allowed a far looser organization. In 1789, for example, Antoine Lavoisier grouped his list of 33 elements into gases, metals, earths, and nonmetals. But chemists longed for a classification scheme that evinced more precision.

Dmitri Mendeleev provided a better framework in 1869 with his precursor to our modern periodic table of elements, organizing them according to the sequence of atomic masses. But there were issues with how he chose to order the elements in his table, and the metals were placed too far to the left.

So the atomic numbers of the elements weren’t as arbitrary as physical chemists originally thought. Moseley’s work provided a firm experimental foundation for Mendeleev’s earlier intuitions, resulting in more accurate positioning of the elements within the periodic table.

In fact, Moseley was able to use this mathematical relationship to correctly identify gaps in the periodic table, predicting that there should be elements with atomic numbers 43, 61, 72, and 75. All these elements were subsequently discovered: two radioactive synthetic elements—technetium and promethium, both created in nuclear reactors—and two naturally occurring elements, hafnium and rhenium. (It also predicted...

ШВАРЦШИЛЬД Карл

Henry Moseley

ШВАРЦШИЛЬД Мартин
(p. 31.V 1912)


Forscher Schwarzschild näher zu kennzeichnen\(^1\)). Es liegt mir vielmehr daran, mit ein paar Strichen sein Wesen und seine Entwicklung zu charakterisieren, weil diese gerade für kommende Forscher vorbildlich sein sollte.


\(^1\) Sobald die Astronomische Gesellschaft jemanden gefunden haben wird, der diese ungeheuer schwere Aufgabe löst, werden auch wir darauf zurückkommen.
Zwölf Monate in russischer Gefangenschaft.¹)

Von Dr. August Kühl, Assistent an der Münchner Sternwarte, z. Z. im Felde.


The first General Assembly of the IAU, held at Rome from 2 to 10
1922. In the President's chair: B. Baillaud. On his right hand, in this
IAU Vice-President 1922-1928). Behind-in between Baillaud and Dyson:
General Secretary A. Fowler, R.G. Aitken, R.P. Cornie, and C.E. St.
E. Strömgren (Copenhagen, Head Central Bureau for Telegrams). (For more
identifications, see Bull. Soc. Astron. de France, September 1922, p. 369.)
on his left hand: Vice-President F. Dyson, P. Stroobant, G. Bigourdan
of the Bureau de l'Heure), G. Armellini, Ch. Lallemant (President of
Collection Utrecht)
The Standing Committees and their first Presidents are listed below [7]:

No. 1, Relativity (A.S. Eddington), *abolished 1925*
No. 2, Re-editing and publication of ancient works (J.L.E. Dreyer),
No. 3, Notations and Units, and the format of publications (P. Stroobant),
* No. 4, Ephemerides (P.H. Cowell), *x*
* No. 5, Abstracts and Bibliography (B. Bailland), *x*
* No. 6, Astronomical Telegrams (G. Lecointe),
* No. 7, Celestial Mechanics and Tables (H. Andoyer), *x*
* No. 8, Meridian Astronomy (S.S. Hough), *x*
* No. 9, Theoretical and Applied Astronomical Optics (M. Hamy), *x*
* No. 10, Solar Radiation (C.G. Abbot), *x*
* No. 11, Spectroscopic Velocities (H. Deslandres),
* No. 12, Atmosphere of the Sun (G.E. Hale), *x*
* No. 13, Astronomical Expeditions (A. de la Baume-Pluvinel),
* No. 14, Wavelength Standards and Spectral Tables for the Sun (C.E. St.John),
* No. 15, Rotation of the Sun (H.F. Newall),
* No. 16, Physics of Planets (V. Cerulli), *x*
* No. 17, Lunar Nomenclature (H.H. Turner),
* No. 18, Radiotelegraphic Longitude Determination (G. Ferrié),
* No. 19, Latitude Variation (H. Kimura),
* No. 20, Minor Planets (E.W. Brown), *x*
* No. 21, Comets (A.O. Leuschner),
* No. 22, Meteorites (W.F. Denning), *x*
* No. 23, Carte du Ciel (H.H. Turner),
* No. 24, Stellar Parallaxes (F. Schlesinger),
* No. 25, Stellar Photometry (F.H. Seares), *x*
* No. 26, Double Stars (R.G. Aitken),
* No. 27, Variable Stars (S.I. Bailey),
* No. 28, Nebulae (G. Bigourdan), *x*
* No. 29, Spectral Classification (W.S. Adams), *x*
* No. 30, Stellar Radial Velocities (W.W. Campbell), *x*
* No. 31, Time (R.A. Sampson), *x*
* No. 32, Calendar Reform (G. Bigourdan).

The reports of these 32 commissions would be the main substance for the General Assembly in 1922.
IAU NATIONAL MEMBERSHIPS

Founders 1920
Belgium, Canada, France, Greece, Italy, Japan, Mexico (1921)
United Kingdom, USA

Round 2, 1922, some neutrals admitted
Czechoslovakia, Denmark, Norway, Poland, Rumania, Spain
Switzerland (1923), Netherlands

Other interwar
Argentina, Australia, China, Yugoslavia, USSR, Portugal,
South Africa, Sweden, Vatican City

Significant "postwar"
Austria (1955), Bulgaria (1957), Germany (1951),
Hungary (1947), Israel (1954), Turkey (1961)

Membership now largely financial issue not war & peace (except perhaps the dual Chinese membership)

THEORY after Great War had slowed dissemination of GR and calculation of its consequences
Friedmann, Lemaitre, de Sitter solutions; Einstein's initial objections and reconsideration
Fig. 5.5. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955), photographed around 1933. (courtesy of the Library of Congress).

Fig. 5.4. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955). Photographed around 1933. (courtesy of the Library of Congress).

Fig. 5.3. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955). Photographed around 1933. (courtesy of the Library of Congress).

Fig. 5.2. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955). Photographed around 1933. (courtesy of the Library of Congress).

Fig. 5.1. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955). Photographed around 1933. (courtesy of the Library of Congress).

Fig. 5.0. Kantare and Einstein, George Tumaire (1894-1906) and Albert Einstein (1879-1955). Photographed around 1933. (courtesy of the Library of Congress).

Fig. 4.1. Einstein and de Sitter. Photographed January 1932 at.

Fig. 4.0. Einstein and de Sitter. Photographed January 1932 at.

Fig. 3.1. Supphwe at the Lowell Obe

Fig. 2.1. Alexander Fischbaren (1888-1925) Fischbaren west

Fig. 1.1. Alexander Fischbaren (1888-1925) Fischbaren west

Fig. 0.1. Alexander Fischbaren (1888-1925) Fischbaren west


Peripheral to main story
but cute pictures
1915 Germany provided Britain with 32,000 pairs of inoculars
through Switz (hoping for rubber in return)
Blackett in Navy (Jutland) in WWII urged Churchill toward
anti-submarine tasks, away from bombs (nuclear) vs Lindemann
Women into labs and colleges; it didn't last
Rudolf Weigl observed typhus; developed vaccine in WWII
Charles Gifford studied battlefield craters - all circular;
deduced lunar craters = impact vs. Volcanic
Kohlschütter PoW in Gibraltar & Maidenhead
Chadwick PoW in Germany, set up lab using equipment from
Geiger & Th from toothpaste (recent Th/toothpaste argument)
"Chemical cabinets" (chemistry sets) disappeared from US; had
used German chemicals
Hale & NRC (1916), detection of U-boats first task; Edison
heading Naval Consulting Board didn't think sci. research
or physicists necessary
London Scottish Regiment included Ronald Colman, Claude Raines,
Herbert Marshall, Cedrick Hardwick, Basil Rathbone
Cambridge & Oxford 2/3 of undergrads enlisted early months, 1/3
of Oxford 1913 class killed for
No direct-line Trimbles fought in US ever (careful choice
of birth years, places, & skills)
Women testing explosives at a factory in Gretna, UK, turned yellow from the toxic TNT and were paid one-third less than their male colleagues.
TERRESTRIAL ANALOG  Lochnagar Crater in northern France, the largest crater formed in World War I, was produced on July 1, 1916 by a massive British mine explosion detonated in the Battle of the Somme during an Allied attempt to break through German lines. The Germans repulsed the attack. The crater is approximately 300 feet (90 meters) across and 70 feet deep.
METEOR CRATER  At the beginning of the 20th century, most scientists thought that Arizona’s Meteor Crater (known then as Coon Butte) was a volcanic structure. Detailed work by Algernon Charles Gifford, Daniel Moreau Barringer, Ernst J. Opik, Ralph Baldwin, Eugene Shoemaker, and other scientists showed how craters such as this one were formed explosively by infalling meteorites.
Soldiers load a Stokes mortar, invented in 1915 by engineer Wilfred Stokes for trench warfare.
Félix Vallotton: Verdun, 1917
DON'T MISS: JULY 26-AUG. 1

The Art of War
Toledo Museum of Art, Ohio, through Oct. 19

Commemorating the centennial of the start of World War I, "The Great War: Art on the Front Line" features paintings, sculpture, and works on paper by artists including Otto Dix, George Grosz and Childe Hassam. At left, Fernand Léger's 1919 sketch for "The City."

(I-r) Toledo Museum of Art, Purchased with funds from the Libbey Endowment, Gift of Edward Drummond Lib
THE PAINTER’s intimate depiction brought viewers into close contact with soldiers, in contrast with the often more scenic views of war photography.
IF I HAD MORE SKILL IN WHAT I'M ATTEMPTING

I WOULDN'T NEED SO MUCH COURAGE.

© ASHLEIGH BRILLIANT 1985.
SANTA BARBARA
Aircraft Detection Horns, WWI Mobile Version
Eighteen-foot horns for locating invisible aircraft devised by a subcommittee of the National Research Council's Committee on Physics during World War I (From the archives of the Academy).
Jean Perrin (1870–1942) with telesite meter (of mysterious purpose), France, 1919.
Cease Fire, 11 a.m., Nov. 11, 1918
The Front Near the River Moselle

"THE END OF THE WAR."
A GRAPHIC RECORD.

One minute before the hour.
All guns firing.

Nov. 11, 1918.
11 A.M.

One minute after the hour.
All guns silent.

This is the last record by sound ranging of artillery activity on the American front near the River Moselle. It is the reproduction of a piece of recording tape as it issued from an American sound-ranging apparatus when the hour of 11 o'clock on the morning of November 11, 1918, brought the general order to cease firing, and the great war came to an end. Six seconds of sound recording are shown. The broken character of the records on the left indicates great artillery activity; the lack of irregularities on the right indicates almost complete cessation of firing; the two breaks in the second line probably being due to the exuberance of a doughboy firing his pistol twice close to one of the recording microphones on the front in celebration of the dawn of peace. The two minutes on either side of the exact armistice hour have been cut from the strip to emphasize the contrast. Sound ranging was an important means of locating the positions and calibers of enemy guns. A description of these wonderful devices, which were a secret with America and the Allies, is given in Book III, chapter 4.
STATUS OF PROJECT

100 or so pages of notes on all sorts of 1914-1919 items, mostly from literature in English.

1000 or so WWI books already exist; science is not a major topic in most of them.


Collaborators in good health welcome!
Don’t take the present moment too seriously —

It won’t be here for long.
SARAJEVO  A century ago, gunfire in what is today a city in Bosnia-Herzegovina sparked a war that killed 9 million. Now, the key words are perseverance and peace. L4
YPRES | A solemn remembrance is staged nightly where the fields hold crosses row on row, a reminder of the tragedy and the triumph that have made this Belgian city more than a symbol. L4
The only requirement for eventually getting there is to keep going in the right direction.