

• The Earth's magnetism

Loadstone attracts iron:

Chinese: Greeks: Samathracian
rings:

Load leading Loring stone

Strasbourg incident

Other import- property also
known for a long time
no apples till 12th cent.

Coy : mariner : degaussing

Columbus deviation from N.S.
instead of pointing true to the pole
of the heavens.

"mariners are charged not to eat
onions or garlic lest the odour may
deprive the load stone of its virtue
& prevent the mariners from seeing
their correct course"

If we seek for their
immediate causes
partly or wholly, without
the least & confine
ourselves to known
scientific grounds
we can only think
of galvanic currents -
But - the atmosphere is
no conductor of ~~electric~~
such currents, neither
is vacuum - space; thus
in speaking in the
upper regions for a ~~to~~
vehicle of galvanic currents
we ~~are going~~ beyond our
knowledge: But - our ignorance
gives us no right - absolutely
to deny the possibility of such currents

6. Bright- advance Gauss's 94%

1200 mls Bostia Peninsula of Canada
Ross Amundsen
S. Victoria Land 750 mls

Place to place

7. Secular variations:

large no. of statistics

(a) lava

(b) sedimentary rocks.

8. 6% upper air: Gauss.
remarkable

9. Diurnal variation 9×10^4
Ext. internal.

10. Origin of ionization
Ultra violet-
3 coincidences
Bright eruptions

12. ~~Magnetic storms.~~
Shape particles
Aurora

13. ~~sun~~ Sun spot correlation

14. Eruptive prominences.
Storms

15. cosmic rays.

16. 2: current Sun's.

Dip discovered soon after
Earth a magnet.

Gilbert = Galileo ^{in one of his dialogues} makes
the mag. Salvatori ^{of} the
book "I highly praise,
admire and envy this author
for having formed such a stuporous
conception on a matter which has
been treated by many sublime
intellects but-solved by none

Gilbert shall live till loadstones
cease to draw
or British fleets the boundless oceans awe.
Dryden.

Biggest- advance since Gilbert-
Gauss's

1200 miles
from
N pole

Boothia peninsula in N. Canada
Ross last cent- / 1903 Amundsen
S pole in S Victoria land in Antarctic
Continent- not- visited
750 miles N.S lie from centre.

P.T.O.

If we seek for the
immediate cause, partly or
wholly, without the earth, &
confine ourselves to the
known sc. grounds we can
only think of galvanic
currents. But the atmosphere
is no conductor of such
currents neither is vacant
space; thus in ~~speaking~~
seeking in the upper regions
for a vehicle of galvanic
currents we go beyond
our knowledge. But our
ignorance gives us no
right absolutely to deny
the possibility of such
currents.

Variations from place to place
geological prospecting

I

Secular variation II

6 wise men of Hidonrothan to leaving much
inclined
who were to see the elephant - tho' all
of them were blind.

6% upper air : Gauss's remarkable
prediction

we know more about the 6%

Diurnal variation : 4 sets
of currents 9×10^4 : External
& internal ; conductivity of
earth.

Origin of ionization : Ultra violet

Prog- 3 coincidences : Radio fade on
Bright. eruptive
mag. dist.

Charged particles : aurorae :
 magnetic storms : radio bursts
 100 miles instead of 1500.

Sun spot correlation :
 slide III

Eruptive prominences
 storms.

Cosmic rays.

~~Sun~~ Explanation of earth's
 mag. field.

The Earth as a Giant Magnet

For a long time the cause of
magnetism, ~~was a very fine~~, ~~unavoidable~~
like any magnetic ~~unavoidable~~
~~to the~~ ~~sake~~ of the common crowd,

The marine ~~the~~ took her out
on the high seas, and since
then ~~the~~ her company has been

much sought after ~~by~~ ~~the~~
~~industries~~. ~~So~~ ~~of~~ we find
her right on the spot, = and

~~we find her almost~~ ~~is~~ ~~in~~ ~~the~~ full
the ~~veriest~~ amateur in radio ~~talks~~ ~~the~~
publicity of ~~the~~ magnetic
line light of newspaper
disturbances in the upper atmosphere.
more has become a common topic in

~~the~~ newspapers and ~~every~~
~~the~~ ~~republic~~ ~~name~~.
know all about ~~the~~ ~~name~~ ~~of~~ Gauss

Gauss that prince among mathematicians
who cultivated mathematics for its own
sake ~~the~~ ~~word~~ ~~de~~ Gauss ~~has~~ ~~already~~ ~~gained~~
respectable place in the Eng. language

meitabini cases to detect: no apt sense in do

magneton

artificial magnets: 100,000 times more intense

than a great mag. lab. & persons expts

leading stone: sandia: lead stone 2g. Louis stone French.

also B.C.

11th cent compass.

~~Ami paper~~

Samostineian rings:

col

and ~~two~~ ¹⁵ months ago ~~no one~~ ^{very few outside papers} ~~except~~ a

physicist would have understood the word

gauss, and much less recognized in

the it the name of one of the world's

greatest mathematicians of all times; ~~who~~

~~should have occurred who~~

The mysterious property possessed by load stone
of attracting iron and similar substances,
seems to have been known from ^{very} long times.
~~Its~~ Tradition attributes the discovery to
the Chinese, near ~~4500~~ ⁴⁵⁰⁰ years ago. ~~In the~~
phenomenon was certainly ~~known~~ ^{familiar} to the
Greeks, as is evidenced by the ~~works~~ ^{works} of the
Samothracian rings, which was generally ~~regarded~~
regarded another ^{an} exhibition of super-
natural powers. The ~~stone~~ ^{magnetic} stone has been
variously designated as load stone
among the Eng. speaking people, as lead
stone among the Scandinavians, and loup
stone by the French. The last name
suggests its association in the popular
mind with ~~the well-known~~ ~~what~~
~~is~~ ~~some~~ ~~times~~ personal magnetism,
which persists among lay men ~~even~~ ~~to~~ ~~day~~.
an association which is by no means rare
even today. I had an experience of it
near two years ago when I attended ~~a~~
conference on magnetism arranged ~~by~~ ~~me~~ ~~at~~ ~~Strasbourg~~ ~~in~~ ~~1888~~

2

Inst. for Int. Cooperation. During one of the
meetings a letter was passed on to me addressed
to the Indian delegate to the Magneton Conference.
It was from a retired Colonel of the French
Army, and contained an offer of free
board and free lodging in Paris, for as
long a time as I would care to stay here,
provided I would teach him personal
magnetism. In spite of the 25 years of
scientific activity by the Saenica Congress, ~~and~~
~~India today~~ ^{to the} ^{away} ^{foreigner} ^{Indi-}
^{land of mysticism} ^{today} is still the land of fakirs & fakirs, of
mystic tricks & mystic practices; and what more natural
than that he should cultivate magnetism of
the mystic type.

The most important property of loadstone,
namely that when freely suspended at one
end of a thin fibre, or when floated on
a piece of wood on water, it tends to
take up the north-south direction, has also
been known from a long time. Its use as
a magnetic compass is at least as
old as the "m" cart. This mysterious
influence which the earth exerts on the suspended

magnet has thus been known for at least 2000 years
and probably much longer, and it is a matter
of no small embarrassment to the Physician
that this common phenomenon still remains
unexplained: ~~I mean it~~ I mean there is hardly
any ~~thing~~ ^{explanation} worth the name, and to speak of
a satisfactory explanation. In this respect it
resembles the common cold, ~~for~~ almost
as old as man, ~~and~~ for which the Physician
is still to find a remedy. Readers of French
will recall the famous poem by ^{A.P.} Hubert in
~~which, after mentioning~~ ~~the~~ referring to the
competency of the Physician to tackle diseases with
~~very~~ ~~complicated~~, almost unpronounceable
names, says

to pos. this and pos. med
the doctor can meet a st. & pretty well
but when it is the common cold
the man is absolutely bowled.

There are two well recognized in which
~~hard~~ difficulties get solved in science. One way
is to meet the difficulty and remove. The second,
which is ~~just~~ ^{almost} as common is to get accustomed
to the diff. The latter has happened for example
in ~~the~~ gravitation, that mysterious force above
which we know as little as we know the

the ^{proof} ~~right~~ of the earth's ~~rotation~~ ^{rotation} ~~is~~ ^{is} a common phenomenon, which obtrudes itself in every day life, ~~as~~ a false step for this platform would be sufficient to convince one of its existence, ~~and~~ if I had not known ~~of~~ about its existence before, and hence ~~we~~ ~~are~~ not ~~so~~ ~~much~~ embarrassed by our ignorance of gravitation, as much as by our ignorance of the earth's magnetic ~~rotation~~ field.

The use of the magnetic compass, by the mariners ~~is~~ dates back to at least the 11th century, as I mentioned, and the ~~use~~ must therefore have been in use for some centuries before Columbus began his ~~well~~ ^{well} to voyages. He seems to have been the 1st to observe that the magnetic needle does not point north ^(except in ~~the~~ regions of the earth) ~~exactly~~ ^{exactly}, but ~~is~~ ^{is} deviated from it considerably. The story is told how on his 1st trans Atlantic voyage, his crew threatened to mutiny ~~on~~ ^{on} seeing the mag. comp. pt- 10° west of north. Naturally no mariners wish to be led ~~into~~ ^{into} ~~the~~ ^{unknown} ~~high~~ ^{seas} ~~to~~ ^{regions} where even the magnetic needle ~~is~~ behaves in a queer way; instead of showing direction "true to the pole of the heavens or the pole star;" ~~and~~ ~~the~~ ~~story~~ ~~also~~

The story further relates how Columbus, ~~had because~~
 stealthily ~~stated~~ ~~related~~ shifted the compass card
 at night, ~~and thus so~~ to make the needle
 (apparently) ~~for~~ north-south, and thus saved the
 situation. This was a very serious thing to do
 since tampering with the compass ~~was~~ was
 a major offence; ~~and~~ according to the statutes
 then obtaining mariners were charged not to eat
 onions or garlic, "lest we should deprive the
 loadstone of its virtue & prevent them ^{men} from
 perceiving their correct course." The punishment ^{even} for
~~the~~ ~~culprit~~ # such offences ^{seems to have been}
 barbarous in the extreme: ^{no punishment in hand of me} ~~the~~ ~~culprit~~ was to be
 pinned to the # mast of the ship with a dagger.

That ~~was~~ a magnetic needle
 when suspended free, does not also point
 horizontally, but has a definite dip dependent
 on the latitude of the place, was discovered

soon after which gave the suggestion
 that the earth ^{was just a magnet. The 1st recognition of it} behaved as
 though it were a ~~large~~ magnet, ^(more or less uniform magnetized sphere) The

~~first~~ probably uniformly magnetized ~~throughout~~
 with its poles ~~at~~ not near the
 slightly ~~at~~ ^{out of the} ~~the~~ ^{the} geographical N + S poles.

The earliest ~~statement~~ ~~of~~ ~~this~~ ~~result~~ ~~is~~ ~~found~~ ~~in~~ ~~1600~~ ~~was~~
~~this~~ ^{was} ~~recognized~~ by Gilbert, in his

~~It is further found that~~ ^{intrinsic} ~~it~~ can be attributed to the ~~magnetism~~ ^{magnetism} of the
 earth itself; ~~this result indeed is very~~
~~satisfactory~~, since it ~~supports~~ ^{is suggested}
 and the earth may be regarded, ~~as a~~
~~at least~~ to a first approximation as a
 uniformly charged sphere, as had been
 conjectured by Gilbert; ~~the magnetic poles~~
~~located~~ the magnetic poles are distant - also
 1200 miles from the geom. poles. The N.P.
~~is~~ ^{is} located on the Boothia Peninsula in N.
 Canada, and was visited by Ross nearly 20
 ago, and ~~visited~~ ^{visited} by Amudsen ⁱⁿ 1825. The
 in the South Vic. land of the Antarctic continent
 has not been visited before. The two poles
 are not diametrically opposite, and the
 lines joining them pass some 750 miles
 away from each other. ~~Thus the~~ ~~poles~~ ~~are~~ ~~not~~ ~~diametrically~~

Apart from these deviations from uniform
 magnetizations, there are also the local
 deviations, evidently ~~are~~ ^{are} closely related to
 the geological structure of the place; and
~~these~~ ~~total~~ ~~are~~ on this has been based
 a method of ^{magnetic} prospecting for ^{certain} ~~magnetic~~ minerals

~~I shall not deal with this~~
 There are also secular variations, ~~which are~~
~~difficult~~ and the period over which reliable
 magnetic data are available, ~~are not sufficient~~
 is not long enough ~~to look up to~~
 for any systematic analysis of these secular
 variations. ~~There are however one or two~~

~~interests of~~ from observations confined ~~to~~
 to centres like Greenwich, ~~Baltimore~~ ~~attempts~~
 have been made to ~~generalise~~, ~~at~~ and ~~attempts~~

There are one or two features, which
 enable us to obtain ~~the~~ magnetic data ~~in~~
 for ~~very~~ ^{very} ~~long~~ periods. ~~It~~ It is a well known
 property of iron, ~~that~~ ^{that} ~~if it is heated to a~~
 high temp it completely loses its magnet above
 a certain ~~critical~~ ^{critical} temp, called the Curie
 temp, ~~it is not~~ ^{it is not} capable of retaining any appreciable
 degree of magnetism. If such a hot body is
 allowed to cool in the presence of a magnetic
 field, it naturally acquires on cooling a magnetic
~~direction~~ ^{direction} whose direction will coincide with the direction
 of the magnetic field. ~~It is~~ ~~that~~ ~~there~~ ~~can~~ ~~occur~~
 even in feeble fields of like the magnetic field
 of the earth. ~~There have been records~~ ~~of~~ ~~some~~
 In volcanic eruptions, where the lava, ~~of~~ ^{which} ~~of~~ magnetic
 materials, cool down, ^{and solidify} under the influence of the
 magnetic field of the earth, leave therefore a

more or less permanent impress of the direction
of the magnetic field. It can give me ^{exact} direction
of the ~~earliest~~ magnetic field ~~from~~ the ~~earliest~~
at the place, at the time of ~~the~~ solidification
of the lava. The dates of ~~the~~ in last-
eruption of some of the worlds ~~for~~ great
volcanoes are known, and it is thus possible
to know the direction of magnetization
of these solidified lava in those regions to
obtain ~~some~~ a ~~idea~~ of the direction of the
earth's field in these regions at ~~the~~
time of the solidification of the lava.

~~Similar~~ also ~~some~~ of the ~~see these~~
is another property of ~~magneto~~ ~~of~~ ~~single~~
information can be obtained for ~~the~~ much
earlier periods from a well known property
of a ~~to~~ ~~which~~ ~~I~~ ~~shall~~ ~~refer~~ ~~the~~
particles, ~~namely~~ their tendency to place their
longest dimensions along the field, ~~has~~ also
been utilized for yielding ~~single~~ data
regarding the previous mag. history at the place
this can be easily demonstrated for example
by suspending an iron wire ~~in a magnetic~~
between the poles of an electro-magnet,
~~when~~ ~~it~~ ~~is~~ ~~with~~ the wire tends to place itself

from plate

white

plate

stone

of

like

of

from ~~plate~~ along the direction of the field for one piece to the other.

Now in sedimentary rocks, some of the particles ~~will~~ had settled down, and are ~~of~~ magnetic materials, and are usually symmetric in shape.

In the same manner sediment of microscopic particles of magnetic material found in the sedimentary rocks I do show a ~~directional~~ ^{preferred} orientation of the particles, and a residual magnetization along the direction of the

to axes. and they supply us today ^{with} a ~~very~~ ^{valuable} record of velocity ~~data~~ ^{data} ~~record~~ ^{record} in ~~the~~ ^{the} ~~past~~ ^{past} as it obtained in a ~~very~~ ^{short} period of remote age.

I mentioned something ago in the analysis of the aerial data on the surface of the earth, ~~do~~ show that 94% ~~do~~ ^{are} can be attributed to ~~from the inside of the~~ ^{causes in fact the earth and the} causes in fact the earth and the ~~remains~~ ^{remains} to causes outside ^{in surface} ~~of~~ ^{of} ~~the~~ ^{the} ~~earth~~ ^{earth} as due to electric currents ~~obtained in~~ ^{obtained in} the ~~upper~~ ^{upper} regions of the earth's atmosphere.

~~and~~ This prediction is indeed very remarkable:
~~since at the time it was made, the atm. was not~~
~~known to be a cond. of Elec.~~ ~~the prediction is suff. I shall take it~~

since this prediction is indeed very remarkable since
 at the time it was made, the atm. was not
 known to be a cond. of Elec. ~~the prediction is suff. I shall take it~~
 of this is what he writes.

I must hasten to mention that ~~the~~
~~prediction~~ ~~has~~ been completely verified ~~is~~ we have today very powerful
 methods of studying the upper regions of the atmosphere
 for example from the propagation of wireless waves -
 indeed propagation of the waves over long distances
 is indeed possible, ~~and~~ on the surface
 of the earth, under favorable conditions right-
 round it, and several times too, is made possible
 by the existence of these electrical conducting
 layers ~~and~~ in the upper regions of the atmosphere
 we have ~~also~~ evidence for the night sky,
 aurora + etc of meters ~~and~~ etc regarding the
 upper atmosphere. But ~~it is good to remember~~ ~~that~~
 these are important regions, ~~which~~ ~~came~~ ~~for~~ ~~the~~ ~~analysis~~
 of the magnetic data on the surface of the earth
 of Gauss. ~~I was a man~~ and we owe ~~it~~
 to a ~~man~~ Gauss. As a mathematician he
 ranks with Br. + Newton, ~~as one of the~~
 and his contributions to magnetism are of no mean
 the best of his work

Indeed this residual 6% ^{we observed} ~~should~~ ~~be~~ ~~due~~ ~~to~~ ~~causes~~ ~~outside~~ ~~the~~ ~~earth's~~ ~~surface~~ ~~is~~ ~~attributed~~ ~~to~~ ~~electric~~ ~~currents~~ ~~in~~ ~~the~~ ~~upper~~ ~~air~~, ~~and~~ ~~is~~ ~~indeed~~ ~~has~~ ~~turned~~ ~~to~~ ~~be~~ ~~a~~ ~~stable~~ ~~source~~ ~~of~~ ~~information~~ ~~very~~ ~~much~~ ~~more~~ ~~interesting~~ ~~than~~ ~~we~~ ~~realize~~ ~~94%~~ ~~of~~ ~~which~~ ~~we~~ ~~know~~ ~~very~~ ~~little~~ ~~of~~ ~~the~~ ~~latter~~. For example there is a ~~simple~~ diurnal variation of ~~and~~ ~~has~~ ~~been~~ ~~proved~~ ~~at~~ ~~every~~ ~~place~~ ~~to~~

I shall speak about the diurnal variation of this contribution, ~~and~~ ~~I~~ ~~shall~~ ~~confine~~ ~~myself~~ ~~to~~ ~~the~~ ~~fact~~ ~~that~~ ~~the~~ ~~variation~~ ~~of~~ ~~the~~ ~~settling~~ ~~is~~ ~~from~~ ~~the~~ ~~normal~~ ~~settling~~. In the northern latitudes, the variations are somewhat like this.

All these variations can be explained as due to ~~large~~ ~~scale~~ ~~a~~ ~~system~~ of electric currents in the upper air and — the system consists of 4 ~~different~~ ^{cloud} circuits ~~one~~ ~~in~~ ~~the~~ ~~northern~~ ~~hemisphere~~ ~~and~~ ~~two~~ ~~in~~ ~~the~~ ~~southern~~, and two ^{under} ~~in~~ ~~the~~ ~~dark~~ ~~half~~ which are much weaker in the dark half of the earth. ~~The~~ ~~total~~ ~~current~~ ~~carried~~ ~~will~~ ~~be~~ ~~to~~ ~~be~~ ~~60~~ ~~to~~ ~~90,000~~ ~~amps.~~

This system of circuits ~~are~~ can be shown to be plausible, ~~for~~ ~~in~~ ~~the~~ ~~first~~ ~~place~~ since the ultra violet light from the sun can be wise the atmosphere to make it sufficiently conductivity and the oscillations of the ~~the~~ atmosphere, ^{found in the magnetic field of earth} can supply the ~~energy~~ dynamic mechanism of these circuits.

Occasionally Now these upper ^{electrically} conducting layers, ~~are~~ in the upper atmosphere are the ones which take part in the propagation of short radio waves. and ~~it~~ any disturbance in the layer ~~can~~ will naturally effect radio propagation, ~~and~~ also the magnetic disturbances,

It has ~~been~~ observed that ~~magnetic disturbances~~ certain radio fade out ~~are~~ ~~are~~ occur almost exactly the same time as the magnetic ~~disturbances~~ & both ~~about~~ just

It has been observed experimentally that the following

(3) phenomena

1. Mysterious property of attraction known for very ancient times

Tradition that Chinese discovered about B.C.

Greeks: ^{word of soul} Lame Thracian rings as part of supernatural powers. Empires should have been discovered so early.

no ppl seem for detecting magnetism; unlike for example ^{not mysterious phenomenon} gravitation; ~~which~~ a false step and

convince. load stone: ~~leading~~ stone = strong stone.

2.

The other property = setting ^{was when first suspected} ~~is~~ as compass, known for 11th c or floated on wood on water = ~~Chinese~~

~~The~~ explicit statement that Earth is a magnet made by Gilbert in 1600. Matter for embarrassment that no explanation still. like common cold =

gravitation: 2 ways of certifying a difficulty

^{next as thing which} 3. true to ^{seems to have been in Columbus} Columbus 10th w. of north: ^{propagated} ~~propagated~~

threatened with mutiny: change the card ⁱⁿ ~~direction~~ ^{direction} ~~direction~~
serious thing to do = penal laws:

meriners forbidden to eat onions or garlic lest the odor deprive the loadstone of its virtue by weakening it + prevent them from perceiving their correct course" - Punishment severe + barbarous = One who had by dagger to the mast

4.

1576 Dip. Robert Norman.

Gilbert, Earth believed as it was a spherical mag.
Galileo's = Dryden

5.

magnetization not large: ^{was in} 10^{-5} of that of good
500 quintillion Helmholtz magnets

6.

6. Gauss : origin traced to inside + outside sphere, spheroid, geoid.

local variations of geom. structures prospecting

750 miles N.P. — S.P.

Secular variation : Period of about 500 yrs : danger of geom. changes

- 7. local variations
- (a) volcanic lava (Curie Pt) gets (six wise new etc.)
- (b) sedimentation.
- (c) clay

8. ~~Diurnal~~ 4% upper air : Gauss's prediction
 on knowledge today

- (a) forming balloons
- (b) use of app. of nucleus
- (c) atmosphere slow
- (d) light for night sky.

contribution from magnetic study.

9. Diurnal variation / Siam Picture
 (External + internal Conductivity of earth)
 currents 9×10^4 amps. in day time in summer.

10. Lunar tides : magnetic disturbances

11. Origin of ionization : Bright eruptions.
 ultra violet light usually near sun spots.
 accompanied by radio fade out.

12. Elec. particles = Aurora : magnetic storms.
 sun spot activity. 100 mil of 1500. Bundle.
 ↓ sun dependence.

13. Cosmic rays.

1
Incertitude still mystery: An error
steps while walking & compass
all the more surprising magnetic
properties discovered so early.

~~of alloy 100,000 times that of the earth~~ We can produce fields
100,000 times in years

Can't get magnetic lab.

load stone: { leading stone Scandinavia
 { loam stone France

Has been used as proof of supernatural skills
a theoric property of load stone exhibited
through its work in the
Samo thracian rings

Samo thrace

When mounted on a block of wood & floated on
water.

Compass used some yrs before Columbus: He was ^{1st} to
discover that the compass does not point true N-S.
"Compass needle as showing direction" true to the pole of the
heavens or pole star.

Threatened mutiny on his ^{1st} transatlantic passage
when the crew saw needle pt- is west of north:
C. shifted the compass card on the needle
Punishment severe?

2

mariners ~~asked~~ changed by statute and
 cat on iron or gallic led - the odour deprive
 the load stone of its virtue by weakening it
 & prevent them from perceiving their correct course.

Robert Norman 1576 dip.
 pted to earth as a magnet. 1600 Gilbert = Earth
 acts as a spherical magnet.

East-Field magnet = lost a giant one = 800 ~~quintillion~~
 quintillion, " one lb magnets of best steel.

North mag. pole visited a century ago 1831
 by Ross, and ~~by~~ by Amundsen in 1903 located in
 Boothia peninsula in Northern Canada.

S. Pole in South Victoria land of Antarctic
 continent as not yet been visited.

Scale

Changes in compass direction ~~at~~ at
 diff places not simply correlated.
 at London north 11° E of N 1580 } complete
 24° W 1818 } Gale of 500 yrs
 11° W of N now

Six wise men of Hindostan to learn much inclined
 who want to see the elephant though all of them were blind

local variations
 related to geological
 features of the earth's
 crust = convergence
 for prospecting.

~~that~~ Anomaly in S. Africa =
 retained for 10 yrs by the huge Pilansberg
 system of Pleistocene volcanic dykes: recently
 examined by Gellatich = 14 vertical dykes
 65 ft. broad, 100 miles long: magnetised in a direction
 4500

opposite to the present field: H has reversed 187.
in 30 yrs!!

Volcanic lava: Mt Etne 1284: consistent
data regarding D & I // 4th cent. B.C. eruptions

Goeth - expt: microscopic magnetic particles in
sediments:

organic structure: magnetic history:

Magnetic crystals
in Earth's field

Clay Firing:

Lamin. 1682 = expts in presence of K₂O


Core samples
from ocean's
bottom: at
various depths:
reconstruction of
past history

Fossil magnetism

See April 1943 no. of Sc. American pp 166+7: article by A. G. Mc Nish [magnetician, Dept of terrestrial magnetism, Carnegie Institution of Washington] Article modified from a paper in Proc. Am. Phil. Soc. (See also Terrestrial Magnetism. recent issues)

Varved Pleistocene clays left at the retreat of the last glaciation best suited

- 1) Show distinct layering - each layer or varve corresponding to a year. Each varve contains a



dark lamina (of finer particles - deposited in winter) and a light lamina [much thicker - large particles deposited in summer] : material probably magnetite - ferromagnetic, aligned in earth's magnetic field.

Magnetite particles washed from the hills over which the ice sheets passed. During the summer thaws these particles washed into the calm waters of the terminal lakes, where they settled to the bottom, large particles at the bottom, and the finer particles during the ensuing winter. Hence the varving

- 2) Their chronology for 7000 years has been reliably established by Ernst Antevs - authority on duration of post-glacial time.

- 3) Have remained essentially in same direction in geographic space ever since

Sediments deposited in lakes bordering ancient-glaciers

estimates and "guesstimates"

American Swedish descent

their deposition.

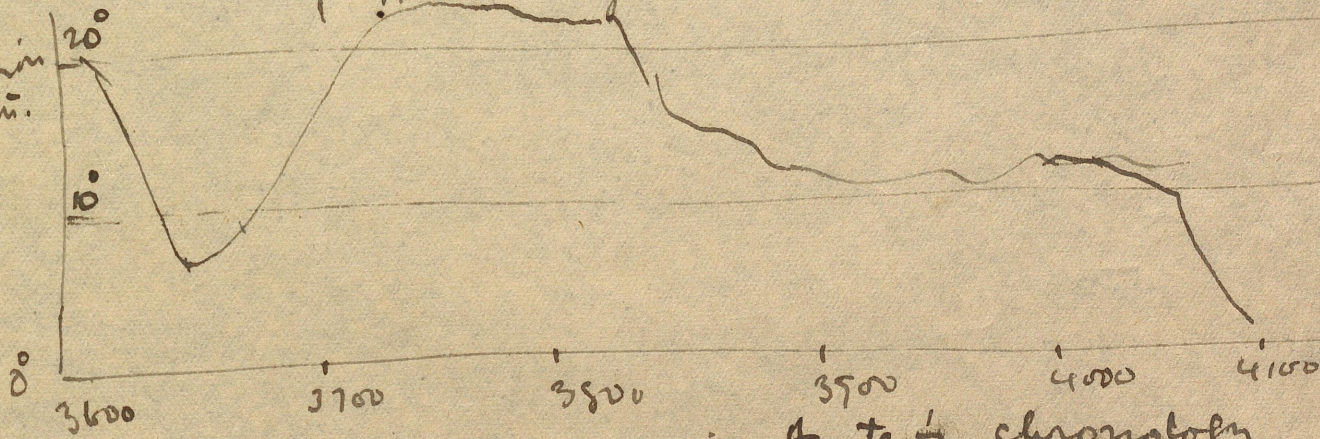
Magnetic directions measured by a method due to E. A. Johnson (of the Dept. of Terrestrial Magnetism, Carnegie Inst. of Wash.) Cutting cubes and rotating them inside a coil

Coercive fields of these deposits fairly large and hence their direction of magnetization not likely to have been affected by changes in earth's field.

- Results:-
- 1) Directions in adjacent ~~layers~~ ^{waves} same
 - 2) In widely separated waves - waves of different ages directions different
 - 3) Separate specimens in same layer - i.e. of same age - collected from different adjoining localities - sometimes several miles apart - give same direction.

Typical curve

Declination
Eq. N.M.



years in Antev's chronology.

Explanation of Earth's magnetism

- 1) Uniform field attributed to a powerful magnet located at the centre of the earth
- 2) Regional field by a set of 14 considerably weaker magnets located midway between centre & surface [at discontinuity between fluid(?) core & mantle] with their axis directed ^{radially, some} towards centre, some away from centre
- 3) Secular variation at present by adding 13 magnets every year — each of $1/100$ strength of magnets in (2), and placed midway between those of (2).

Extensive data regarding secular change due to Fisk.

See obituary notice R.S. de Geer regarding his contributions to geochronology.

Ditto of all of one sign.

- occasional appearance
1. ~~apl. development~~ of aurora & disturbance in lower
latitudes, ^{central + location Europe} not explained

It was study of Earth's mag. ch. ^{it} gave us a
Knowledge of ^{elec. properties of} upper atmosphere

Today sound balloons
meters app. + dis appear
Reflex sound waves.
Wireless waves
light for night - 8/3: aurora

Intensity of magnetism of earth -
0.074 $\frac{1}{5500}$ of the remnant
magnetism of cobalt steel

$78\frac{1}{2}^{\circ}$ N 69° W.

Equivalent intensity great for these latitudes
where land predominates

$11\frac{1}{2}^{\circ}$.