

G/over

not added

but ^{not} should
be considered

36

A Compilation of Papers
Relevant to the Biological Effects of Magnetic Fields

William C. Gough
AEC's Division of Controlled
Thermonuclear Research
April 4, 1973

W. C. Levengood, Nature, March 5, 1966, p 1009-1013

A probe with a field strength at the surface of 21,000 gauss and a field gradient of 9,000 gauss/mm within the first two mm from the tip was used on the developing reproduction organs of flies. Retardation of the development time of pupa was observed to continue for ten generations. Alteration in development time was initiated through the male sperm rather than the female egg. Abnormalities were observed.

- (2) "A New Teratogenic Agent Applied to Amphibian Embryos", W. C. Levengood, J. Embryol. Exp. Morph., Vol. 21, page 23-31, February 1969

To study vertebrates, amphibian eggs and embryos were exposed to magnetic probes with field strengths of 6,300 gauss and 17,700 gauss and a field gradient in the first 2 mm from the tip of 3,900 gauss/mm and 11,000 gauss/mm respectively. Gross abnormalities were observed including extra limbs.

- (3) "Abnormalities in Organs of Mice Induced by a Magnetic Field", M. F. Barnothy, Nature, Vol. 221, Jan. 18, 1969

Mice were exposed for 13 days to a 9,000 gauss magnetic field.

- (4) "High Gradient Magnetic Field Inhibits Embryonic Development of Frogs", Felix Gutmann, Nature, Vol. 219, September 28, 1968

The embryos were exposed to 10,000 gauss with a gradient of 8,350 gauss/cm along the axis. It was concluded that exposure to the magnetic field prevents normal embryonic development.

- (5) "Effect of Magnetic Fields on the Respiration of Malignant, Embryonic and Adult Tissue", J. C. Fardon, M. E. Poydock, G. Basulto, Nature, July 23, 1966, page 433

Intermittent 6000 gauss magnetic field affected the respiration of adult mouse kidney tissue. A constant field had no effect.

- (6) "Responses of Planarian and Snails", (extracts from), F. H. Barnwell and F. A. Brown, Jr., Biological Effects of Magnetic Fields, M. J. Barnothy, ed., Plenum Press, N. Y. 1964.

Concludes that "there remains no reasonable doubt that living systems are extraordinarily sensitive to magnetic fields" and "that the organism is normally integrated with its geomagnetic environment to a striking degree".

- (7) "The 'Clocks' Timing Biological Rhythms", Frank A. Brown, Jr., American Scientist, November-December 1972

Concludes that the biological clock phenomenon results from a continuous interaction between the organism's metabolically maintained electromagnetic fields and those of its geophysical environment.

- (8) "Actions of a Very Weak Magnetic Gradient: The Reflex of the Dowser", Y. Rocard, Biological Effects of Magnetic Fields, M. F. Barnothy, ed., Plenum Press, New York 1964

Illustrates the sensitivity of the human body for detecting small magnetic gradients of 0.3 to 0.5 m oersteds/meter. Notes narrow range over which this sensitivity exists. Suggests nuclear magnetic resonance within the body as an explanation for dowsing.

- (9) "A Perfect Case of Serendipity -- Paleomagnetism Continues Its Surprising Impact on the Study of the Earth", article based on discussion with Allan Cox, Mosaic, Vol. 3, No. 2, Spring 1972, published by NSF.

Gives data on reversal of the Earth's magnetic field, a theory for reversals, and the correspondence between magnetic reversals and the extinction of species. Also see "Geomagnetic Polarity Change and Faunal Extinction in the Southern Ocean", N. D. Watkins and G. G. Goodell, Science, May 26, 1967.

- (10) "Geomagnetic Parameters and Psychiatric Hospital Admissions", H. Friedman, R. O. Becker, C. H. Bachman, Nature, Vol. 200, p. 626-628, November 16, 1963.

A significant relationship was shown between psychiatric disturbance as reflected in hospital admissions and natural magnetic field intensity.

- (11) "Psychiatric Ward Behavior and Geophysical Parameters", H. Freedman, R. O. Becker, and C. H. Bachman, Nature, Vol. 205, page 1050-1052, March 13, 1965

Statistically significant relationships of striking magnitude between cosmic ray indexes and ward behavior can be observed in the majority of schizophrenic patients, particularly when compared with the strong geomagnetic disturbances that occur 1-2 days later.

- (12) "Effect of Magnetic Fields on Reaction Time Performance",
H. Friedman, R. O. Becker, C. H. Bachman, Nature, March 4, 1967

A slowing down of reaction time for men was observed in a sinusoidally modulated field of 5-11 gauss at 0.2 cycles/sec. No significant effect was observed for steady state fields or those modulated at 0.1 cycle/sec.

- (13) "Magnetoencephalography: Evidence of Magnetic Fields Produced by Alpha-Rhythm Currents" David Cohen, Science, Vol. 161, p. 784-786, August 23, 1968

Fluctuating magnetic fields of 1×10^{-9} gauss were measured around the human head as a result of the brain's 8-13 Hz alpha-rhythm currents.

- (14) "Magnetomyography: Magnetic Fields Around the Human Body Produced by Skeletal Muscles", David Cohen and Edward Givler, Appl. Phys. Lett., Vol. 21, No. 3, August 1, 1972

A plot of the magnetic field due to currents generated by skeletal muscles over the frequency range from 0-300 Hz is given. Notes that fluctuating magnetic fields from urban disturbances may be more than 5×10^{-4} gauss (rms) in a bandwidth of 0-40 Hz while the human heart's field at maximum is 5×10^{-7} gauss.

- (15) "Some Studies on the Biological Effects of Magnetic Fields", H. Aceto, Jr., C. A. Tibias, I. L. Silver, IEEE Transactions on Magnetics, Vol. MAG-6, No. 2, June 1970

A review type article with 46 references. Notes that effect of magnetic field may vary depending upon temperature since there are critical temperature transition points for many biological phenomena. Also notes that in a magnetic field, oxygen, a paramagnetic molecule, becomes more toxic.

- (16) "A Possible Effect of the Magnetic Field Upon the Genetic Code", M. F. Barnothy, Biological Effects of Magnetic Fields, M. F. Barnothy, ed., Plenum Press, N. Y. 1964

Proposes that a magnetic field can increase or decrease the stability of the genetic code by changing the energy levels of the nucleotide bases which would change the depth of the potential wells and hence change the proton tunnelling probability.

- (17) "Heliobiology", Alexander Dubrov, Soviet Life, January 1972

Claims that permeability of cell membranes is under the direct control of the magnetic field of the Earth and that the process of evolutionary changes in an organism under natural conditions depends primarily on the fluctuations of the geomagnetic field.

- (18) "Electromagnetic Forces and Life Processes", R. O. Becker, Technology Review, December 1972, page 32-38.

Discusses naturally occurring electronic control systems within living organisms. Found that within a narrow range, certain cells when stimulated by direct currents of 1-3 m μ amps would break up into a more primitive cell type and that this primitive material would then reform into those cell types needed for a particular tissue repair process. They thus conclude that low level electric currents and potentials, produced either by direct injection or by rectification and induction from external fields, have the capability of bringing about very major biological effects of a very basic nature.