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BABY

Bronowski, Jacob 1908–74
Polish-born British mathematician and polymath

The human baby, the human being, is a mosaic of animal and angel.

The Ascent of Man
Lower than the Angels (p. 31)
Little, Brown & Co. Boston, Massachusetts, USA. 1973

BACKBONELESS

Bradley, Jr., John Hodgdon 1898–1962
American geologist

Backboneless marine animals are the creatures of the sea in which they live. Like the sea itself they are sluggish, if not entirely sedentary. Like the rest of us they are products of their environment.

Parade of the Living
Part I, Chapter V (p. 55)
Coward-McCann, Inc. New York, New York, USA. 1930

BACTERIA

Cohn, Ferdinand Julius 1828–98
German botanist and bacteriologist

At last, in the most recent times, an unexpected knowledge of the secret life energies of bacteria has been revealed, through which they rule with demoniacal power over the weal and woe, and even over the life and death of man.

Bacteria: The Smallest of Living Organisms
Lüder. Berlin. 1872

If one could inspect a man under a similar lens-system he would appear as big as Mont Blanc or even as Mt. Chimborazo. But even under these colossal magnifications the smallest bacteria look no larger than the periods and commas of good print; little or nothing can be distinguished of their inner parts, and of them their very existence would have remained unsuspected if it had not been for their countless numbers.

In Kenneth Thimann
The Life of Bacteria: Their Growth, Metabolism, and Relationships
Chapter II (p. 33)
The Macmillan Company. New York, New York, USA. 1963

Dyer, Betsey Dexter 1954–
American biologist

Before refrigeration, when seafood might be kept a few days in a chilly basement, this phenomenon of glowing decay [from bacteria] was observed and noted. Charles Dickens, in *A Christmas Carol*, likens Marley's face in the knocker of Scrooge's door to a glowing lobster: "Marley's face...had a dismal light about it, like a bad lobster in a dark cellar." How many nonmicrobiologists have passed over that line, unable to decipher what image Dickens had in mind?

A Field Guide to Bacteria
Chapter 8 (p. 131)
Cornell University Press. Ithaca, New York, USA. 2003

Feynman, Richard P. 1918–88
American theoretical physicist

The proteins of bacteria and the proteins of humans are the same. In fact it has recently been found that the protein-making machinery in the bacteria can be given orders from the red cells to produce red cell proteins. So close is life to life.

The Meaning of It All: Thoughts of a Citizen Scientist
Chapter I (p. 11)
Perseus Books. Reading, Massachusetts, USA. 1998

Grassé, Pierre P. 1895–1985
French zoologist

Bacteria, the study of which has formed a great part of the foundation of genetics and molecular biology, are the organisms which, because of their huge numbers, produce the most mutants. This is why they gave rise to an infinite variety of species, called strains, which can be revealed by breeding or tests. Like *Erophila verna*, bacteria, despite their great production of intraspecific varieties, exhibit a great fidelity to their species. The bacillus *Escherichia coli*, whose mutants have been studied very carefully, is the best example. The reader will agree that it is surprising, to say the least, to want to prove evolution and to discover its mechanisms and then to choose as a material for this study a being which practically stabilized a billion years ago!

Evolution of Living Organisms: Evidence for a New Theory of Transformation
Chapter III (p. 87)
Academic Press. New York, New York, USA. 1977

Haber, Fritz 1868–1934
German physical chemist

Nitrogen bacteria teach us that Nature, with her sophisticated forms of the chemistry of living matter, still understands and utilizes methods, which we do not as yet know how to imitate.

Nobel Lectures, Chemistry 1901–1921
The Synthesis of Ammonia from Its Elements
Elsevier Publishing Co. Amsterdam, The Netherlands. 1966

Harrisons' Nurseries

The work of bacteria is like that of the buzzards, which gather from everywhere and consume a dead body.

How to Grow and Market Fruit

Lime Action (p. 21)

Harrison's Nurseries. Berlin, Maryland, USA. 1911

Helmuth, William Tod 1833–1902

American physician

Oh, powerful bacillus,
With wonder how do you fill us,
Every day!

While medical detectives,
With powerful objectives,
Watch you play.

"Scratches" of a Physician

Ode to the Bacillus

W.A. Chatterton & Company. Chicago, Illinois, USA. 1879

Mayo, Charles Horace 1865–1939

American physician

The philosophic view of bacteria is to consider them necessary to life as the minute chemists of the air, waste, and the soil.

Stone in the Kidney

Annals of Surgery, Volume 7 1920

Paulos, John Allen 1945–

American mathematician

We are trying to measure bacteria with a yardstick.

New York Times, 22 November, 2000 (p. A31)

Peattie, Donald Culross 1898–1964

American botanist, naturalist, and author

No picture of life today is even worth a glance that does not show the bacteria as the foundation of life itself, the broad base of the pyramid on which all the rest is erected.

An Almanac for Moderns

November Twenty-Seventh (p. 275)

G.P. Putnam's Sons. New York, New York, USA. 1935

The bacteria are only the most primitive, and adaptable-to-the-primitive beings that are at present known. They may have had – may still have – antecedents even more hardy and fitted to digest the raw stuff of the universe, perhaps even the interstellar calcium that is one of the recent discoveries of the watchers of the skies.

An Almanac for Moderns

November Thirtieth (p. 278)

G.P. Putnam's Sons. New York, New York, USA. 1935

Postgate, John

No biographical data available

Life manages very well without oxygen, evolving into flourishing communities of anaerobes. Acidity...presents

no problem, as sulphur bacteria and their co-habitants illustrate, nor does a considerable degree of alkalinity bother alkophiles.... Water purity is a trivial matter: saturated salt brines support abundant bacterial life. And pressure is quite irrelevant, with bacteria growing happily in a near vacuum or at the huge hydrostatic pressure of deep ocean trenches. Temperature, too, presents little problem: boiling hot springs support bacterial life, and bacteria have been found growing at 112° C in superheated geothermal water under hydrostatic pressure; conversely, other types of bacteria thrive at well below zero, provided the water is salty enough not to freeze. And even if they do get frozen, many bacteria revive when their habitat thaws. Even organic food is not a prerequisite ...

The Outer Reaches of Life

Chapter 18 (p. 251)

Cambridge University Press. Cambridge, England. 1994

Tyndall, John 1820–93

Irish-born English physicist

We have been scourged by invisible throngs, attacked from impenetrable ambuscades, and it is only today that the light of science is being let in upon the murderous dominion of our foes.

In H.H. Newman (ed.)

The Nature of the World and of Man

In Edwin O. Jordan

The Bacteria (p. 215)

The University of Chicago Press. Chicago, Illinois, USA. 1927

Wallin, Ivan E. 1883–1969

American biologist

It is a rather startling proposal that bacteria, the organisms which are popularly associated with the disease, may represent the fundamental causative factor in the origins of species.

Symbioticism and the Origin of Species

Chapter I (p. 8)

Williams & Wilkins Company. Baltimore, Maryland, USA. 1927

Zinsser, Hans 1878–1940

U.S. bacteriologist

...infectious disease is merely a disagreeable instance of a widely prevalent tendency of all living creatures to save themselves the bother of building, by their own efforts, the things they require. Whenever they find it possible to take advantage of the constructive labors of others, this is the path of least resistance. The plant does the work with its roots and its green leaves. The cow eats the plant. Man eats both of them; and bacteria (or investment bankers) eat the man.

Rats, Lice and History

Chapter II (pp. 8–9)

Transaction Publishers

Somerset, New Jersey, USA. 2007

BACTERIOLOGIST

Andrewes, Frederick William 1859–1932

British pathologist

It may very properly be asked whether the attempt to define distinct species, of a more or less permanent nature, such as we are accustomed to deal with amongst the higher plants and animals, is not altogether illusory amongst such lowly organised forms of life as the bacteria. No biologist nowadays believes in the absolute fixity of species...but there are two circumstances which here render the problem of specificity even more difficult of solution. The bacteriologist is deprived of the test of mutual fertility or sterility, so valuable in determining specific limits amongst organisms in which sexual reproduction prevails. Further, the extreme rapidity with which generation succeeds generation amongst bacteria offers to the forces of variation and natural selection a field for their operation wholly unparalleled amongst higher forms of life.

‘The Evolution of the Streptococci’

The Lancet, Volume 2, 1906 (p. 1415)

Doyle, Sir Arthur Conan 1859–1930

Scottish writer

I’m a bacteriologist, you know. I live in a nine-hundred-diameter microscope. I can hardly claim to take serious notice of anything that I can see with my naked eye. I’m a frontiersman from the extreme edge of the Knowable, and I feel quite out of place when I leave my study and come into touch with all you great, rough, hulking creatures.

The Lost World

Chapter II (p. 18)

Hodder & Stroughton. New York, New York, USA. 1912

BAG-LIMIT

Hornaday, William Temple 1854–1937

American naturalist

The fatalistic idea that bag-limit laws can save the game is today *the curse of all our game birds, mammals and fishes!* It is a fraud, a delusion and a snare. That miserable fetch has been worshipped much too long. Our game is being exterminated, everywhere, by blind insistence upon “open seasons,” and solemn reliance upon “legal bag-limits.”

Our Vanishing Wild Life: Its Extermination and Preservation

Preface (p. x)

Charles Scribner’s Sons. New York, New York, USA. 1913

BALANCE

Chargaff, Erwin 1905–2002

Austrian biochemist

A balance that does not tremble cannot weigh.

Heracleitean Fire: Sketches from a Life Before Nature

Part III

The Trembling of a Balance (p. 179)

Rockefeller University Press. New York, New York, USA. 1978

Johnston, James Finlay Weir 1796–1855

Scottish chemist

...the first object one notices is a glass case standing on a table. It is the balance. How much light this fragile, simple instrument has shed on the natural sciences! How many phenomena it has explained! How many hidden truths it has revealed! Who could enumerate the discussions it has ended, the hypotheses it has destroyed! Who, in former times, would have believed that the determination of abstract truths and the development of the laws of nature would depend on the oscillations of this moving beam!

In Mary Elvira Weeks

The Discovery of the Elements (pp. 533–534)

Journal of Chemical Education. Easton Pennsylvania, USA. 1956

von Liebig, Justus 1803–73

German organic chemist

For all great discoveries chemists are indebted to the “balance” – that incomparable instrument which gives permanence to every observation, dispels all ambiguity, establishes truth, detects error, and guides us in the true path of inductive science.

Familiar Letters in Chemistry

Letter I (p. 6)

Taylor & Walton. London, England. 1843

BAROMETER

Berry, John J.

No biographical data available

We often hear it said that however reliable the fluctuations of the barometer may be in other sections, as indicating the approach of storms, upon the Pacific Coast some exceptional rule or, rather, no rule exists, and that the variations of the barometer really indicate nothing. And when we find, as we often do, that the movement of the mercury accompanies, instead of preceding by hours and days, storms of wind or rain, we are very apt to regard instrument and indications alike as wholly unreliable.

Life of David Belden

Chapter V (p. 105)

Beldon Brothers. New York, New York, USA. 1891

Bierce, Ambrose 1842–1914
American newspaperman, wit, and satirist

BAROMETER, n. An ingenious instrument which indicates what kind of weather we are having.

The Cynic's Word Book
Barometer (p. 28)

Doubleday, Page & Co. New York, New York, USA. 1906

BATHYBIUS

Huxley, Thomas Henry 1825–95
English biologist

Bathybius [is] a vast sheet of living matter, enveloping the whole earth beneath the seas.

On Some Organisms Living at Great Depths in the North Atlantic Ocean
Microscopical Journal, October, 1868

BAYESIAN

Kadane, Joseph
Statistician

I believe that assumptions are useful to state in statistical practice because they impose a discipline on the user. Once a full set of assumptions is stated, the conclusion should follow. (Actually, only a Bayesian analysis can meet this standard, but that's another topic for another time.)

Comment

Statistical Science, Volume 1, Number 1, February, 1986 (p. 12)

Wang, Chamont 1949–
Statistician

...there are at least 46,656 varieties of Bayesians.

Sense and Nonsense of Statistical Inference: Controversy, Misuse, and Subtlety

Chapter 6 (p. 158)

Marcel Dekker. New York, New York, USA. 1993

BEACH

Jones, Thomas Rymer 1810–80
English surgeon and zoologist

And now, gentle reader, let us hasten to the beach: the tide is near its ebb, and yonder rocks, baring their shoulders to the sunshine, seem to rest themselves in grim repose.

This is the time for work. Come boy! The fishing basket and the muslin landing-net – a hammer and an iron chisel. Mind, too, you don't forget the large glass jar with handles made of rope, wherein to put what specimens we find.

The Aquarian Naturalist: A Manual for the Sea-Side
John van Voorst. London, England. 1858

Morton, Ron L.
No biographical data available

Beaches are nomads, have been nomads, and always will be nomads. Our attempts to shape them into our image of what we think they should be is a lost cause if ever there was one.

Music of the Earth: Volcanoes, Earthquakes, and Other Geological Wonders

Chapter 8 (p. 227)

Plenum Press. New York, New York, USA. 1996

Tennyson, Alfred (Lord) 1809–92
English poet

Here about the beach I wandered, nourishing a youth sublime

With the fairy tales of science, and the long results of time.

Alfred Tennyson's Poetical Works

Locksley Hall, Stanza 6

Oxford University Press, Inc. London, England. 1953

BEAK

Ruskin, John 1819–1900
English writer, art critic, and social reformer

I do not think it is distinctly enough felt by us that the beak of a bird is not only its mouth, but its hand, or rather its two hands. For, as its arms and hands are turned into wings, all it has to depend upon, in economical and practical life, is its beak. The beak, therefore, is at once its sword, its carpenter's tool-box, and its dressing-case; partly also its musical instrument; all this besides its function of seizing and preparing the food, in which functions alone it has to be a trap, carving-knife, and teeth, all in one.

Love's Meinie

Lecture 1, 20 (pp. 20–21)

John Wiley & Son. New York, New York, USA. 1873

BEAUTY

Abbey, Edward 1927–89
American environmentalist and nature writer

All we have, it seems to me, is the beauty of art and nature and life, and the love which that beauty inspires.

The Journey Home: Some Words in Defense of the American West

Chapter 4 (p. 57)

E.P. Dutton. New York, New York, USA. 1977

Angier, Natalie 1958–
Writer and science journalist

The beauty of the natural world lies in the details, and most of those details are not the stuff of calendar art.

The Beauty of the Beastly: New Views on the Nature of Life

Introduction (p. xi)

Houghton Mifflin & Co. Boston, Massachusetts, USA. 1995

Aristotle 384 BCE–322 BCE
Greek philosopher

Now since the good and the beautiful are different...those who assert that the mathematical sciences say nothing of the beautiful or the good are in error. For these sciences say and prove a great deal about them; if they do not expressly mention them, but prove attributes which are their results or definitions, it is not true that they tell us nothing about them. The chief forms of beauty are order and symmetry and definiteness, which the mathematical sciences demonstrate in a special degree.

In *Great Books of the Western World* (Volume 8)

Metaphysics

Book XIII, Chapter 3, 1078a [30]

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

The mathematical sciences particularly exhibit order, symmetry, and limitation; and these are the greatest forms of the beautiful.

In *Great Books of the Western World* (Volume 8)

Metaphysics

Book XIII, Chapter 3 (p. 610)

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Awiakta, Marilou 1936–
Native American writer

Beauty is no threat to the wary
who treat the mountain in its way,
the copperhead in its way,
and the deer in its way,
knowing that nature is the human heart
made tangible.

Selu: Seeking the Corn-Mother's Wisdom

Trail Warning (p. 39)

Fulcrum Publishers. Golden, Colorado, USA. 1993

Bacon, Sir Francis 1561–1626
English lawyer, statesman, and essayist

There is no excellent beauty that hath not some strangeness in the proportion.

In Brian Vickers (ed.)

Francis Bacon

Essays of Beauty (p. 425)

Published for the British Council by Longman. Harlow, England. 1978

Boltzmann, Ludwig Edward 1844–1906
Austrian physicist

Certain methods have frequently yielded the most beautiful results, and many persons have been tempted to believe that the development of science to the end of all time would consist in the systematic and unremitting application of them. But suddenly they begin to show indications of impotency, and all efforts are then bent upon discovering new and antagonistic methods. Then there usually arises a conflict between the adherents of the old method and those of the new. The point of view of

the former is characterized by its opponents as antiquated and obsolete; whilst its upholders in their turn look down with scorn upon the innovators as perverters of true classical science.

The Recent Development of Method in Theoretical Physics

The Monist, Volume 11, 1901 (p. 229)

Bridges, Robert Seymour 1844–1930
English poet

For beauty being the best of all we know
Sums up the unsearchable and secret aims
Of nature.

Poetical Works of Robert Bridges (Volume 1)

The Growth of Love, 8 (p. 226)

Smith, Elder & Company. London, England. 1898

Bryan, J. Ingram
No biographical data available

Nature seems to exist only to satisfy man's thirst for beauty; it is her way of teaching him confidence in the integrity of the Universe...

The Interpretation of Nature in English Poetry

Chapter I (p. 1)

Kaitakusha. Tokyo, Japan. 1932

Burke, Edmund 1729–97
British statesman and philosopher

The stomach, the lungs, the liver, as well as other parts, are incomparably well adapted to their purposes; yet they are far from having any beauty.

On the Sublime and the Beautiful

Part III, Section VI (p. 196)

Printed for F.C. & J Rivington & others. London, England. 1812

Cayley, Arthur 1821–95
English mathematician

It is difficult to give an idea of the vast extent of modern mathematics. The word “extent” is not the right one: I mean extent crowded with beautiful detail – not an extent of mere uniformity such as an objectless plain, but of a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail of hillside and valley, stream, rock, wood, and flower. But, as for everything else, so for mathematical theory – beauty can be perceived but not explained.

The Collected Mathematical Papers of Arthur Cayley (Volume 11)

Presidential Address, British Association, September, 1883 (p. 449)

The University Press. Cambridge, England. 1889–97

Chandrasekhar, Subrahmanyan 1910–95
Indian-born American astrophysicist

This “shuddering before the beautiful,” this incredible fact that a discovery motivated by a search after the beautiful in mathematics should find its exact replica in Nature, persuades me to say that beauty is that to

which the human mind responds at its deepest and most profound.

Truth and Beauty: Aesthetics and Motivations in Science

Chapter 3, Section VI (p. 54)

The University of Chicago Press. Chicago, Illinois, USA. 1987

All of us are sensitive to nature's beauty. It is not unreasonable that some aspects of this beauty are shared by the natural sciences.

Beauty and the Quest for Beauty in Science

Physics Today, Volume 32, Number 7, July 1979 (p. 25)

Coleridge, Stephen 1854–1936

English author, barrister, and opponent of vivisection

Science strives day and night to blind men's eyes so that they shall not see it, and where it succeeds men are robbed of a perfect and stainless happiness; for the appreciation and perception of beauty is its own reward, it confers pleasure that is utterly pure, it fosters in the mind refined and tender feelings and emotions, it elevates the character and fills the heart with wonder and love and gratitude...

The Idolatry of Science

Chapter XII (p. 99)

John Lane Co. London, England. 1920

Collins, Wilkie 1824–89

English novelist

Admiration of those beauties of the inanimate world, which modern poetry so largely and so eloquently describes, is not, even in the best of us, one of the original instincts of our nature. As children, we none of us possess it. No uninstructed man or woman possesses it. Those whose lives are exclusively passed amidst the ever-changing wonders of sea and land are also those who are most universally insensible to every aspect of Nature not directly associated with the human interest of their calling. Our capacity of appreciating the beauties of the earth we live on is, in truth, one of the civilized accomplishments which we all learn, as an art; and, more, that very capacity is rarely practiced by any of us except when our minds are most indolent and most unoccupied.

The Woman in White

The Story Begun by Walter Hartright

Chapter VIII (p. 43)

Everyman's Library. London, England. nd

Copernicus, Nicolaus 1473–1543

Polish astronomer

Among the many and varied literary and artistic studies upon which the natural talents of man are nourished, I think that those above all should be embraced and pursued with the most loving care which have to do with things that are very beautiful and very worthy of knowledge.

In *Great Books of the Western World* (Volume 16)

On the Revolutions of the Heavenly Spheres

Book One (p. 510)

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Curie, Marie Skłodowska 1867–1934

Polish-born French physicist and chemist

I am among those who think that science has great beauty.... A scientist in his laboratory is not only a technician but also a child placed in front of natural phenomena which impresses him like a fairy tale.

In *Eve Curie*

Madame Curie

Chapter XXIV (p. 341)

The Literary Guild of America, Inc. New York, New York, USA. 1937

da Vinci, Leonardo 1452–1519

Italian High Renaissance painter and inventor

Even though the genius of man might make various inventions, attaining the same end by various means, it will not invent anything more beautiful, or more economical, or more direct than nature, for in nature's inventions nothing is wanting and nothing is superfluous.

In Theodosius Dobzhansky

Evolution of Genes and Genes in Evolution

Cold Spring Harbor Symposia on Quantitative Biology

Volume XXIV, 1959 (p. 15)

Cold Spring Harbor Laboratory. Cold Spring Harbor, New York, USA.

Darwin, Charles Robert 1809–82

English naturalist

How the sense of beauty in its simplest form – that is, the reception of a peculiar kind of pleasure from certain colours, forms, and sounds – was first developed in the mind of man and of the lower animals, is a very obscure subject. The same sort of difficulty is presented, if we enquire how it is that certain flavours and odours give pleasure, and others displeasure.

The Origin of Species (6th edition)

Chapter VI (p. 162)

John Murray. London, England. 1882

Davy, Sir Humphry 1778–1829

English chemist

Amidst the various infinitely diversified changes of things, nothing can be said to be accidental or without design. Even the most terrible of the ministrations of nature in their ultimate operation are pregnant with blessings and with benefits. Beauty and harmony are made to result from apparent confusion, and all the laws of the material world are ultimately made subservient to the preservation of life and the promotion of happiness.

Humphry Davy on Geology: The 1805 Lectures for the General Audience

Lecture Ten (p. 139)

The University of Wisconsin Press. Madison, Wisconsin, USA. 1980

Dickinson, Emily 1830–86

American lyric poet

Beauty – be not caused – It is...

The Complete Poems of Emily Dickinson

No. 516 (p. 252)

Little, Brown, Boston & Company. Boston, Massachusetts, USA. 1960

Dirac, Paul Adrien Maurice 1902–84
English theoretical physicist

We may try to make progress by following in Hamilton's footsteps, taking mathematical beauty as our guiding beacon, and setting up theories which are of interest, in the first place, only because of the beauty of their mathematics. We may then hope that such equations will ultimately prove their value in physics, basing this hope on the belief that Nature demands mathematical beauty in her laws.

Hamiltonian Methods and Quantum Mechanics
Proceedings of the Royal Irish Academy, Volume 63, Section A, Number 3, January, 1964 (p. 59)

The researcher worker, in his efforts to express the fundamental laws of Nature in mathematical form, should strive mainly for mathematical beauty. He should still take simplicity into consideration in a subordinate way to beauty.... It often happens that the requirements of simplicity and beauty are the same, but where they clash the latter must take precedence.

The Relation Between Mathematics and Physics
Proceedings of the Royal Society (Edinburgh), Volume LIX, February 25, 1939 (p. 124)

It is quite clear that beauty does depend on one's culture and upbringing for certain kinds of beauty, pictures, literature, poetry and so on.... But mathematical beauty is of a rather different kind. I should say perhaps it is of a completely different kind and transcends these personal factors. It is the same in all countries and at all periods of time.

In Helge Kragh
Dirac: A Scientific Biography
Chapter 14 (p. 288)
Cambridge University Press. Cambridge, England. 1990

Dretske, Fred I. 1932–
American philosopher

Beauty is in the eye of the beholder, and information is in the head of the receiver.

Knowledge and the Flow of Information
Preface (p. vii)
Center for the Study of Language and Information, Leland Stanford Junior College, USA. 1999

Duhem, Pierre-Maurice-Marie 1861–1916
French physicist and mathematician

It is impossible to follow the march of one of the greatest theories of physics, to see it unroll majestically its regular deductions starting from initial hypotheses, to see its consequences represent a multitude of experimental laws down to the smallest detail, without being charmed by the beauty of such a construction, without feeling keenly that such a creation of the human mind is truly a work of art.

The Aim and Structure of Physical Theory
Part I, Chapter II (p. 24)
Princeton University Press. Princeton, New Jersey, USA. 1954

Emerson, Ralph Waldo 1803–82
American lecturer, poet, and essayist

Beauty is the form under which the intellect prefers to study the world.

The Conduct of Life
Beauty (p. 225)
Houghton Mifflin Co. Boston, Massachusetts, USA. 1894

We ascribe beauty to that which is simple; which has no superfluous parts; which exactly answers its end.

Ralph Waldo Emerson: Essays and Lectures
The Conduct of Life
Beauty (p. 1093)
The Library of America. New York, New York, USA. 1983

Beauty rests on necessities. The line of beauty is the line of perfect economy.

Ralph Waldo Emerson: Essays and Lectures
The Conduct of Life
Beauty (p. 1097)
The Library of America. New York, New York, USA. 1983

For the world is not painted, or adorned, but is from the beginning beautiful; and God has not made some beautiful things, but Beauty is the creator of the Universe.

Ralph Waldo Emerson: Essays and Lectures
Essays: Second Series
The Poet (p. 449)
The Library of America. New York, New York, USA. 1983

Erdős, Paul 1913–96
Hungarian mathematician

It's like asking why Beethoven's Ninth Symphony is beautiful. If you don't see why, someone can't tell you. I *know* numbers are beautiful. If they aren't beautiful, nothing is.

Quoted in Paul Hauffman
The Man Who Loves Only Numbers
The Atlantic Magazine, Volume 260, Number 5, November, 1987 (p. 44)

Gross, David J. 1941–
American particle physicist

At the fundamental level nature, for whatever reason, prefers beauty and is marvelously inventive in inventing new forms of beauty.

The Role of Symmetry in Fundamental Physics
Proceedings of the National Academy of Science USA, Volume 93, Number 25, December 10, 1996

Heisenberg, Werner Karl 1901–76
German physicist and philosopher

If nature leads to mathematical forms of great simplicity and beauty – to forms that no one has previously encountered – we cannot help thinking that they are true and that they revealed genuine features of Nature.

Selected Papers S. Chandrasekhar (Volume 7)
The Series Paintings of Claude Monet and the Landscape of General Relativity (p. 138)
The University of Chicago Press. Chicago, Illinois, USA. 1997

...beauty in exact science, no less than in the arts is the most important source of illumination and clarity.

Across the Frontiers

Chapter XIII (p. 183)

Harper & Row, Publishers. New York, New York, USA. 1974

Hilbert, David 1862–1943

German mathematician

Our Science, which we loved above everything, had brought us together. It appeared to us as a flowering garden. In this garden there were well-worn paths where one might look around at leisure and enjoy oneself without effort, especially at the side of a congenial companion. But we also liked to seek out hidden trails and discovered many an unexpected view which was pleasing to our eyes; and when the one pointed it out to the other, and we admired it together, our joy was complete.

In Constance Reid

Hilbert – Courant

Hilbert

Chapter XV (p. 121)

Springer-Verlag. New York, New York, USA. 1986

Holmes, Oliver Wendell 1809–94

American physician, poet, and humorist

...wisdom is the abstract of the past, but beauty is the promise of the future.

The Professor at the Breakfast Table

Chapter II (p. 44)

Houghton Mifflin Co. Boston, Massachusetts, USA. 1916

Huntley, Henry Edwards

No biographical data available

Nature's beauty dies. The day dawns when the nautilus is no more. The rainbow passes, the flower fades away, the mountain crumbles, the star grows cold. But the beauty in mathematics – the divine proportion, the golden rectangle, *spira mirabilis* – endures for evermore.

The Divine Proportion: A Study in Mathematical Beauty

Chapter XIII (p. 176)

Dover Publications. New York, New York, USA. 1970

Jefferies, Richard 1848–87

English nature writer

The exceeding beauty of the earth, in her splendor of life, yields a new thought with every petal. The hours when the mind is absorbed by beauty are the only hours when we really live[A]ll else is illusion, or mere endurance.

The Pageant of Summer

Eclectic Magazine of Foreign Literature, Science, and Art, Volume

XXXVIII, Number 2, August, 1883 (p. 146)

Kelvin, Lord William Thomson 1824–1907

Scottish engineer, mathematician, and physicist

The scientific man sees and feels beauty as much as any mere observer – as much as any artist or painter. But he also sees something underlying that beauty; he wishes to learn something of the actions and forces producing those beautiful results.

Popular Lectures and Addresses (Volume 2)

The Bangor Laboratories

Address

Physical and Chemical Laboratories in University College

Bangor, North Wales, February 2, 1885 (p. 477)

Macmillan & Company Ltd. London, England. 1894

Kolb, Edward W. (Rocky) 1951–

American cosmologist

To those who say Newton removed the hand of God from the heavens, I say he replaced a toilsome hand of brute force with a sublime hand of beauty.

Blind Watchers of the Sky

Chapter Five (p. 135)

Addison-Wesley Publishing Company. Reading, Massachusetts, USA.

1996

Kragh, Helge 1944–

Science historian

The main problem is that beauty is essentially subjective and hence cannot serve as a commonly defined tool for guiding or evaluating science. It is, to say the least, difficult to justify aesthetic judgment by rational arguments.... The sense of aesthetic standards is part of the socialization that scientists acquire; but scientists, as well as scientific communities, may have widely different ideas of how to judge the aesthetic merit of a particular theory. No wonder that eminent physicists do not agree on which theories are beautiful and which are ugly.

Dirac: A Scientific Biography

Chapter 14 (pp. 287–288)

Cambridge University Press. Cambridge, England. 1990

Lax, Peter 1926–

Hungarian-born American mathematician

I like to start with some phenomenon, the more striking the better, and then use mathematics to try to understand it.... There's an aesthetic quality, yes, but if you try to pin that down, you are just begging the question. What is beautiful is purely subjective. Saying something is beautiful may be no different from saying that you have a feeling that something is important. You know, one of the complaints that pure mathematicians have against applied mathematicians is that it is ugly. ...Beauty is in the eye of the beholder. It's a poor guide, aesthetics is. You have to feel that what you are doing is beautiful but, after all, someone used to classical art regards modern art as horrible and ugly.

In D. Albers, G. Alexanderson and C. Reid

More Mathematical People: Contemporary Conversations (p. 155)

Harcourt Brace Jovanovich. Boston, Massachusetts, USA. 1990

Leibniz, Gottfried Wilhelm 1646–1716
German philosopher and mathematician

The beauty of nature is so great and its contemplation so sweet...whoever tastes it can't help but view all other amusements as inferior.

Translated by Elizabeth Oehlkers

In Ernest Peter Fischer

Beauty and the Beast

Chapter 2 (p. 47)

Plenum Trade. New York, New York, USA. 1999

Mach, Ernst 1838–1916
Austrian physicist and philosopher

Generally speaking, anything that is constructed according to fixed and logically followed rules, is a product of tolerable beauty.

Translated by Thomas J. McCormack

Popular Scientific Lectures (2nd edition)

The Economical Nature of Physical Inquiry (p. 91)

The Open Court Publishing Co. Chicago, Illinois, USA. 1897

Maxwell, James Clerk 1831–79
Scottish physicist

Nothing beautiful can be produced by Man except by the laws of mind acting in him as those of Nature do without him; and therefore the kind of beauty he can thus evolve must be limited by the very small number of correlative sciences which he has mastered; but as the Theoretic and imaginative faculty is far in advance of Reason, he can apprehend and artistically reproduce natural beauty of a higher order than his science can attain to; and as his Moral powers are capable of a still wider range, he may make his work the embodiment of a still higher beauty, which expresses the glory of nature as the instrument by which our spirits are exercised, delighted,

In Lewis Campbell and William Garnett

The Life of James Clerk Maxwell

Appendix A (p. 343)

Macmillan & Co Ltd. London, England. 1884

Mendeleyev, Dmitry Ivanovich 1834–1907
Russian chemist

To conceive, understand, and grasp the whole symmetry of the scientific edifice, including its unfinished portions, is equivalent to tasting that enjoyment only conveyed by the highest forms of beauty and truth.

Translated by George Kamensky

The Principles of Chemistry (Volume 1)

Author's Preface to the Fifth Edition (p. ix)

Longmans, Green & Co. London, England. 1891

Misner, Charles W.
American physicist

Thorne, Kip S. 1940–
American theoretical physicist

Some day a door will surely open and expose the glittering central mechanism of the world in all its beauty and simplicity.

In Charles W. Misner et al

Gravitation

Part X, Chapter 44 (p. 1197)

W.H. Freeman & Company. San Francisco, California, USA. 1973

Moore, Benjamin
No biographical data available

The ordered beauty of the world of Nature suggests an infinite intelligence with powers of action such as no man...possesses ...

The Origins of Nature and Life

Chapter I (p. 23)

Henry Holt & Co.. New York, New York, USA. 1913

Muir, John 1838–1914
American naturalist

Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul alike.

The Yosemite

Chapter 15 (p. 192)

Sierra Club Books. San Francisco, California, USA. 1988

Oppenheimer, James Robert 1904–67
American theoretical physicist

Science is not everything. But science is very beautiful.

With Oppenheimer on an Autumn Day

Look, Volume 30, Number 26, December 27, 1966 (p. 63)

The profession I'm part of has, as its whole purpose, the rendering of the physical world understandable and beautiful. Without this you have only tables and statistics.

With Oppenheimer on an Autumn Day

Look, Volume 30, Number 26, December 27, 1966 (p. 63)

Penrose, Roger 1931–
English mathematical physicist

A beautiful idea has a much greater chance of being a correct idea than an ugly one.

The Emperor's New Mind: Concerning Computers, Minds, and the

Laws of Physics

Chapter 10 (p. 421)

Oxford University Press, Inc. Oxford, England. 1989

Poincaré, Jules Henri 1854–1912
French mathematician and theoretical astronomer

...what are the mathematical entities to which we attribute this character of beauty and elegance, and which are capable of developing in us a kind of aesthetic emotion?

They are those whose elements are harmoniously disposed so that the mind without effort can embrace their totality while realizing the details. This harmony is at once a satisfaction of our aesthetic needs and an aid to the mind, sustaining and guiding.

The Foundations of Science

Science and Method

Book I, Chapter III, Section I (p. 391)

The Science Press. New York, New York, USA. 1913

Proust, Marcel 1871–1922

French novelist

...beauty is a sequence of hypotheses which ugliness cuts short when it bars the way that we could already see opening into the unknown.

Translated by C.K. Scott Moncrief

Within a Budding Grove

Part Two, Place-Names: The Place (p. 14)

The Modern Library. New York, New York, USA. 1951

Raman, Chandrasekhar Venkata 1888–1970

Indian physicist

The concept of beauty defies abstract analysis.

The New Physics: Talks on Aspects of Science

Chapter IV (p. 23)

Philosophical Library, New York. 1951

Reddy, Francis

Science writer

Walz-Chojnacki, Grey

Science writer

We live in an age when the complex and forbidding explanations of science often masks the simple beauty of nature.

Celestial Delights

Introduction (p. ix)

Celestialarts. Berkeley, California, USA. 1992

Rice, Harvey 1800–91

American lawyer and newspaper publisher

In every star, in every flower, in every blade of grass, in every grain of sand, in every tiling visible and invisible, there is life, light, and beauty.

Nature and Culture

Chapter III (p. 129)

Robbins, R. Robert

American Archaeoastronomer

Jefferys, William H. 1940–

American astronomer

The beauty of the night sky can be overwhelming.

Discovering Astronomy (3rd edition)

Preface (p. vii)

John Wiley & Sons, Inc. New York, New York, USA. 1995

Ruskin, John 1819–1900

English writer, art critic, and social reformer

In all arts or sciences, before we can determine what is just or beautiful in a group, we must ascertain what is desirable in the parts which compose it...

The Poetry of Architecture: Cottage, Villa, Etc

The Villa (p. 81)

John Wiley & Sons. New York, New York, USA. 1877

Sartre, Jean-Paul 1905–80

French existentialist philosopher and novelist

The real is never beautiful. Beauty is a value which applies only to the imaginary and which entails the negation of the world in its essential structure.

In Theodosius Dobzhansky

The Biology of Ultimate Concern

Chapter 5 (p. 102)

The New American Library, Inc. New York, New York, USA. 1967

Shaftesbury, Anthony Ashley Cooper 1671–1713

English philosopher

There is no one who, by the least progress of science or learning, has come to know barely the principles of mathematics, but has found, that in the exercise of his mind on the discoveries he there makes, though merely of speculative truths, he receives a pleasure and delight superior to that of sense. When we have thoroughly searched into the nature of this contemplative delight, we shall find it of a kind which relates not in the least to any private interest of the creature, nor has for its object any self-good or advantage of the private system.

Characteristics of Men, Manners, Opinions, Times, etc. (Volume 1)

Treatise IV, Book II, Part II, Section I (p. 296)

G. Richards. London, England. 1900

Smale, Stephen 1930–

American mathematician

Beauty is very integrated with rarity.... Beauty is connected so much with innovation and priority.... [In mathematics], it has to be something special to make it beautiful. If it's just ordinary, it's not beautiful.

In D. Albers, G. Alexanderson and C. Reid

More Mathematical People: Contemporary Conversations (p. 320)

Harcourt Brace Jovanovich. Boston, Massachusetts, USA. 1990

Steensen, Niels 1638–86

Danish anatomist and naturalist

Beautiful are the things we see

More beautiful those we understand

Much the most beautiful those we do not comprehend.

Introductory Lecture

Copenhagen Anatomical Theater 1673

Thurston, William Paul 1946–

American mathematician

The inner force that drives mathematicians isn't to look for applications; it's to understand the structure and inner beauty of mathematics.

In D. Albers, G. Alexanderson and C. Reid

More Mathematical People: Contemporary Conversations (p. 335)

Harcourt Brace Jovanovich. Boston, Massachusetts, USA. 1990

Wallace, Lew 1827–1905

American statesman and writer

...beauty is altogether in the eye of the beholder:...

The Prince of India: or, Why Constantinople Fell (Volume 1)

Book III, Chapter VI (p. 178)

Harper & Brothers Publishers. New York, New York, USA. 1893

Weil, Simone 1909–43

French philosopher and mystic

The true subject of science is the beauty of the world.

Translated by Elizabeth Oehlkens

In Ernest Peter Fischer

Beauty and the Beast

Chapter 5 (p. 91)

Plenum Trade. New York, New York, USA. 1999

Wheeler, John Archibald 1911–

American physicist and educator

The beauty in the laws of physics is the fantastic simplicity that they have.

In Paul Buckley and F. David Peat (eds.)

Glimpsing Reality: Ideas in Physics and the Link to Biology

John Archibald Wheeler (p. 96)

University of Toronto Press. Toronto, Ontario, Canada. 1996

Wilde, Oscar 1854–1900

Irish wit, poet, and dramatist

Beauty is a form of Genius – is higher, indeed, than Genius, as it needs no explanation.

The Picture of Dorian Gray

Chapter 2 (pp. 24–25)

The Modern Library. New York, New York, USA. 1992

BEGINNING

Ramsay, Sir William 1852–1916

English chemist

Like every other endeavor, the beginning is in small things. Anyone who tries to look into anything with sufficient care will find something new. A drop of water; a grain of sand; an insect; a blade of grass; we know indeed little about them when all is told.

Essays Biographical and Chemical

Chemical Essays

How Discoveries Are Made (p. 116)

Archibald Constable & Company Ltd. London, England. 1908

Snyder, Carl 1869–1946

American economist and statistician

A veil hides from us the beginning of things. So far as we can now see, it will never be lifted. Equally from our view is veiled the end.

The World Machine: The First Phase the Cosmic Mechanism

Chapter XXXIV (p. 459)

Longmans Green. London, England. 1904

BEHAVIOR

Dostoevsky, Fyodor Mikhailovich 1821–81

Russian writer

...every insect, ant, and golden bee, all so marvelously know their path, though they have not intelligence ...

Translated by Constance Garnett

Great Books of the Western World Volume 52

The Brothers Karamazov

Book VI, Chapter 1 (p. 153)

Encyclopaedia Britannica, Inc. Chicago, Illinois, USA. 1952

Medawar, Sir Peter Brian 1915–87

Brazilian-born English zoologist

Goodness knows how it [genetics of behavior] is to be got at. It may be outflanked or it may yield to attrition, but probably not to direct assault. No scientist is admired for failing in the attempt to solve problems that lie beyond his competence. The most he can hope for is the kindly contempt earned by the Utopian politicians.

The Strange Case of the Spotted Mice and Other Classic Essays

Chapter 4 (p. 42)

Oxford University Press. Oxford, England. 1996

BELIEF

Buchner, Ludwig 1824–99

German physician and philosopher

Individual human qualities and imperfections are transferred to philosophical notions, and belief is made to occupy the place of actual knowledge.

Force and Matter

Chapter I (p. 7)

Trubner & Co

London, England. 1864

Darwin, Charles Robert 1809–82

English naturalist

Thus disbelief crept over me at a very slow rate, but was at last complete. The rate was so slow that I felt no distress, and have never since doubted even for a second that my conclusion was correct. I can indeed hardly see how anyone ought to wish Christianity to be true; for if so the plain language of the text seems to show that the men who do not believe, and this would include my Father, Brother and almost all of my friends, will be everlastingly punished.

And this is a damnable doctrine.

The Autobiography of Charles Darwin, 1809–1882: With Original Omissions Restored
Religious Belief (p. 87)
Harcourt, Brace. New York, New York, USA. 1959

At some future period, not very distant as measured by centuries, the civilised races of man will almost certainly exterminate, and replace, the savage races throughout the world. At the same time the anthropomorphous apes, as Professor Schaaffhausen has remarked, will no doubt be exterminated. The break between man and his nearest allies will then be wider, for it will intervene between man in a more civilised state, as we may hope – [more civilized] than the Caucasian, and some ape as low as a baboon, instead of as now between the negro or Australian and the gorilla.

In *Great Books of the Western World* (Volume 49)
The Descent of Man
Part I, Chapter VI (p. 336)
Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

de Morgan, Augustus 1806–71

English mathematician and logician

...belief is but another name for imperfect knowledge...

Formal Logic: Or, The Calculus of Inference, Necessary and Probable
Chapter IX (p. 173)
Taylor & Walton. London, England. 1847

Dewar, Redcote

No biographical data available

Man's beliefs are generally, but not always, according to his knowledge, hence, if his knowledge be scant, his opinions are correspondingly grotesque.

From Matter to Man: A New Theory of the Universe
Chapter XI (p. 131)
Chapman & Hall, Ltd. London, England. 1898

Heinlein, Robert A. 1907–88

American science fiction writer

I don't "believe" in anything. I know certain things – little things, not the Nine Billion Names of God – from experience. But I have no beliefs. Belief gets in the way of learning.

Time Enough for Love
Prelude, Chapter II (p. 41)
G.P. Putnam's Sons. New York, New York, USA. 1973

Huxley, Thomas Henry 1825–95

English biologist

Every belief is the product of two factors: the first is the state of mind to which the evidence in favor of that belief is presented; and the second is the logical cogency of the evidence itself.

Collected Essays (Volume 2)
Darwiniana
The Coming of Age of "The Origin of Species" (p. 230)
Macmillan & Company Ltd. London, England. 1904

Redi, Francesco 1626–78

Italian physician

Belief [that worms in meat were derived from the droppings of flies] would be vain without the confirmation of experiment, hence in the middle of July, I put a snake, some fish, some eels of the Arno, and a slice of milk-fed veal in four large, wide-mouthed flasks; having well closed and sealed them, I then filled the same number of flasks in the same way, only leaving these open.

Translated by Mab Bigelow
Experiments on the Generation of Insects
Meat in Sealed Flasks (p. 33)
The Open Court Publishing Company. Chicago, Illinois, USA. 1909

Robinson, James Harvey 1863–1936

American historian and educator

We are incredibly heedless in the formation of our beliefs, but find ourselves filled with an illicit passion for them when anyone proposes to rob us of their companionship. It is obviously not the ideas themselves that are dear to us, but our self-esteem, which is threatened.

The Mind in the Making
Chapter II (p. 40)
Harper & Brothers Publishers. New York, New York, USA. 1921

Sayers, Dorothy L. 1893–1957

English novelist and essayist

But you see, I can believe a thing without understanding it. It's all a matter of training.

Strong Poison and Have His Carcase
Have His Carcase
Chapter XXII (p. 301)
Harcourt, Brace & Company. New York, New York, USA. No date

Shaw, George Bernard 1856–1950

Irish comic dramatist and literary critic

There is no harder scientific fact in the world than the fact that belief can be produced in practically unlimited quantity and intensity, without observation or reasoning, and even in defiance of both, by the simple desire to believe founded on a strong interest in believing.

The Doctor's Dilemma
Preface on Doctors
Credulity and Chloroform (p. xviii)
Brentano's. New York, New York, USA. 1920

BELIEFS

Sagan, Carl 1934–96

American astronomer and author

We are constantly prodding, challenging, seeking contradictions or small, persistent residual errors, proposing alternative explanations, encouraging heresy. We give our highest rewards to those who convincingly disprove established beliefs.

Demon-Haunted World: Science As a Candle in the Dark
Chapter 2 (p. 33)
Random House, Inc. New York, New York, USA. 1995

BENEFACTOR

Rowland, Henry Augustus 1848–1901
American physicist

He who makes two blades of grass grow where one grew before is the benefactor of mankind; but he who obscurely worked to find the laws of such growth is the intellectual superior as well as the greater benefactor of the two.

The Physical Papers of Henry Augustus Rowland
The Highest Aims of the Physicist (p. 669)
The Johns Hopkins Press. Baltimore, Maryland, USA. 1902

BENZENE THEORY

Kekule, August 1829–96
German organic chemist

Someone has said that the benzene theory appeared like a meteor from the sky. It came absolutely new and uninitiated. The human mind does not work in this manner. Nothing has ever been thought of which is absolutely new, certainly not in chemistry...

In Harry Clary Jones
A New Era in Chemistry
Chapter I (p. 13)
D. van Nostrand Co. New York, New York, USA. 1913

BESSEL FUNCTION

Feynman, Richard P. 1918–88
American theoretical physicist

When I see equations, I see the letters in colors – I don't know why. As I'm talking, I see vague pictures of Bessel functions from Jahnke and Ernde's book, with light-tan j's, slightly violet-bluish n's, and dark brown x's flying around. And I wonder what the hell it must look like to the students.

What Do You Care What Other People Think?
It's as Simple as One, Two, Three... (p. 59)
W.W. Norton & Company, Inc. New York, New York, USA. 1988

BETA DECAY

Wu, Chien-Shiung 1912–97
Chinese-American physicist

Beta decay was...like a dear old friend. There would always be a special place in my heart reserved especially for it.

In H. B. Newman and T. Ypsilantis (eds.)
History of Original Ideas and Basic Discoveries in Particle Physics
Parity Violation (pp. 390–391)
Plenum Press. New York, New York, USA. 1996

BEWILDERED

Darwin, Charles Galton 1809–82
English naturalist

...the more I think the more bewildered I become...
In Francis Darwin
The Life and Letters of Charles Darwin (Volume 2)
Darwin to Asa Gray, May 22, 1860 (p. 106)
D. Appleton & Co. New York, New York, USA. 1887

BIBLIOGRAPHER

Minot, Charles Sedgwick 1852–1914
American anatomist

The biological bibliographer is like an explorer in a forest – he finds no open way to travel, but must laboriously hunt for the specimens which belong in the same class according to our intellectual systems, and which he must discover as they lie scattered, unclassified, and, all too often, concealed.

Biological Lectures Delivered at the Marine Biological Laboratory of Wood's Hole
Tenth Lecture (pp. 149–150)
Ginn & Co. Boston, Massachusetts, USA. 1896

BIBLIOGRAPHY

de Cervantes, Miguel 1547–1616
Spanish novelist, playwright, and poet

Now let us come to those references to authors which other books have, and you want for yours. The remedy for this is very simple; You have only to look out for some book that quotes them all, from A to Z as you say yourself, and then insert the very same alphabet in your book, and though the imposition may be plain to see, because you have so little need to borrow from then, that is no matter; there will probably be some simple enough to believe that you have made use of them all in this plain, artless story of yours. At any rate, if it answers no other purpose this long catalogue of authors will serve to give a surprising look of authority to your book.

In *Great Books of the Western World* (Volume 29)
The History of Don Quixote de la Mancha
Preface (p. xiii)
Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Weil, André 1906–98
French mathematician

We know only too well...that one should not invariably assume a mathematician to be fully aware of the work of his predecessors, even when he includes it among his references; which one of us has read all the books he has listed in the bibliographies of his own writings?

In Raymond George Ayoub
Musings of the Masters: An Anthology of Mathematical Reflections
History of Mathematics (p. 210)
Mathematical Association of America. Washington, D.C. 2004

BIFOCAL VISION

Mach, Ernst 1838–1916

Austrian physicist and philosopher

I have no doubt that you, ladies, have frequently received delicate compliments upon your eyes, but I feel sure that no one has ever told you, and I know not whether it will flatter you, that you have in your eyes, be they blue or black, little geometers. You say you know nothing of them? Well, for that matter, neither do I. But the facts are as I tell you.

Translated by Thomas J. McCormack

Popular Scientific Lectures (2nd edition)

Why Has Man Two Eyes? (pp. 71–72)

The Open Court Publishing Co. Chicago, Illinois, USA. 1897

BIG BANG

Alphonsus X 1221–84

Castilian monarch and patron of the sciences

...a certain King of Castile, a great mathematician, (but not much troubled with religion) said, that, “had God consulted him when he made the world, he would have told him how to have framed it better.”

In Bernard de Fontenelle

Conversations on the Plurality of Worlds

The First Evening (pp. 13–14)

Printed for Peter Wilson. Dublin, Ireland. 1761

Ball, Philip 1962–

English science writer

Origins are seldom uncontentious. Current fashion sometimes has it that the idea of a cosmic Big Bang is best regarded as our latest cultural myth, as much a social construct as the slaying of Ymir. On the one hand, it can only be arrogant to suggest otherwise; on the other, it’s this particular kind of confidence that makes science possible.

Life’s Matrix: A Biography of Water

Part One, Chapter 1 (p. 5)

Farrar, Straus & Giroux. New York, New York, USA. 2000

Čapek, Milič 1909–97

Czechoslovakian philosopher and physicist

World history thus began by a “super-radioactive explosion” of the original single quantum, and the development of the universe is a continuation of this process of fragmentation of energy into the increasing number of smaller and smaller quanta. The enormous energy of the cosmic rays is merely a “fossil remnant” of the high-frequency radiation from the original phase of cosmic history.

The Philosophical Impact of Contemporary Physics

Chapter XVII (p. 352)

D. van Nostrand Company, Inc. Toronto, Ontario, Canada. 1961

Cardenal, Ernesto 1925–

Nicaraguan poet and Roman Catholic priest

And that was Big Bang.

The Great Explosion.

The universe subjected to relations of uncertainty, its radius of curvature undefined, its geometry imprecise with the uncertainty principle of Quantum Mechanics.

Translated by John Lyons

Cosmic Canticle

Cantigua 1, Big Bang (p. 11)

Curbstone Press. Willimantic, Connecticut, USA. 1993

Ehrenreich, Barbara 1941–

American social critic and essayist

If that’s how it all started, then we might as well face the fact that what’s left out there is a great deal of shrapnel and a whole bunch of cinders (one of which is, fortunately, still hot enough and close enough to be good for tanning).

The Worst Years of Our Lives

Blocking the Gates to Heaven (p. 267)

Pantheon Books. New York, New York, USA. 1981

Ferris, Timothy 1944–

American science writer

We have at present only two kinds of physics to choose from, classical and quantum; and classical physics, as Alex Vilenkin notes, “fails to describe the beginning of the universe.” Its breakdown is clearly signaled by the fact that general relativity invokes a singularity at time zero, which is to say that its equations yield infinities and can produce no meaningful result. Roger Penrose and a youthful Stephen Hawking proved this in 1970, in theorems demonstrating that if gravitation is always attractive and if the universe has anything like the matter density we observe to have, then there must have been a singularity at the outset of time. So we are left with quantum cosmology – the attempt to apply quantum precepts, previously employed in studying subatomic particles and fields, to the universe as a whole.

The Whole Shebang: A State-of-the-Universe’s Report

The Origin of the Universe (p. 249)

Simon & Schuster. New York, New York, USA. 1996

The term “big bang” was coined with derisive intent by Fred Hoyle, and its endurance testifies to Sir Fred’s creativity and wit. Indeed, the term survived an international competition in which three judges – the television science reporter Hugh Downs, the astronomer Carl Sagan, and myself – sifted through 13,099 entries from 41 countries and concluded that none was apt enough to replace it. No winner was declared, and like it or not, we are stuck with “big bang.”

The Whole Shebang: A State-of-the-Universe’s Report

Notes, 10 (p. 323)

Simon & Schuster. New York, New York, USA. 1996

Gamow, George 1904–68
Russian-born American physicist

God was very much disappointed, and wanted first to contract the Universe again, and to start all over from the beginning. But it would be much too simple. Thus, being almighty, God decided to correct His mistake in a most impossible way.

And God said: "Let there be Hoyle." And there was Hoyle. And God looked at Hoyle...and told him to make heavy elements in any way he pleased.

And Hoyle decided to make heavy elements in stars, and to spread them around by supernova explosions.

My World Line: An Informal Autobiography

Chapter 6 (p. 127)

The Viking Press. New York, New York, USA. 1979

Guth, Alan 1947–
American physicist

...the big bang theory is not really a theory of a bang at all. It is only a theory of the aftermath of a bang...the standard big bang theory says nothing about what banged, why it banged, or what happened before it banged.

The Inflationary Universe: The Quest For a New Theory of Cosmic Origins

Preface (p. xiii)

Addison-Wesley Publishing Company, Inc. Reading, Massachusetts, USA. 1997

Hoyle, Sir Fred 1915–2001
English mathematician, astronomer, and writer

The big bang theory requires a recent origin of the Universe that openly invites the concept of creation.

The Intelligent Universe

Chapter 9 (p. 237)

Holt, Rinehart & Winston. New York, New York, USA. 1983

On scientific grounds this big bang assumption is much the less palatable of the two [steady state theory or point source origin theory]. For it is an irrational process that cannot be described in scientific terms.

The Nature of the Universe

Chapter 6 (p. 124)

The University Press. Cambridge. 1933

A major reason for the popularity of big-bang theory is undoubtedly that it is simple enough to place no burden on the mind. Undoubtedly, too, there are many who are attracted by its retreat into metaphysics. For myself, I find the retreat into nonexplanation unsatisfactory, contrasting so markedly with the exquisite subtlety of all science outside cosmology. Can the Universe really be so crude while the rest is so refined?

Home Is Where the Wind Blows: Chapters from a Cosmologist's Life

Part Three, Chapter 24 (p. 354)

University Science Books, Mill Valley, California, USA. 1994

Big-bang cosmology is a form of religious fundamentalism, as is the furor over black holes, and this is why

these peculiar states of mind have flourished so strongly over the past quarter century. It is in the nature of fundamentalism that it should contain a powerful streak of irrationality and that it should not relate, in a verifiable, practical way, to the everyday world. It is also necessary for a fundamentalist belief that it should permit the emergence of gurus, whose pronouncements can be widely reported and pondered on endlessly – endlessly for the reason that they contain nothing of substance, so that it would take an eternity of time to distill even one drop of sense from them. Big-bang cosmology refers to an epoch that cannot be reached by any form of astronomy, and, in more than three decades, it has not produced a single successful prediction.

Home Is Where the Wind Blows: Chapters from a Cosmologist's Life

Part Three, Chapter 28 (pp. 413–414)

University Science Books, Mill Valley, California, USA. 1994

An ultimate theory, like the Holy Grail, is something the physicist must always seek but will never find.

Ten Faces of the Universe

The Physicist's Universe (p. 34)

W.H. Freeman & Company. San Francisco, California, USA. 1977

It is a suspicious feature of the explosion theory that no obvious relics of a superdense state of the Universe can be found.

Frontiers of Astronomy (p. 322)

Harper & Row, Publishers. New York, New York, USA. 1955

Jeffers, Robinson 1887–1962
American poet

...there is no way to express that explosion; all that exists

Roars into flame, the tortured fragments rush away from each other into all the sky, new universes

Jewel the black breast of night; and far off the outer nebulae like charging spearmen again

Invade emptiness.

No wonder we are so fascinated with fire-works.

The Beginning and the End and Other Poems

The Great Explosion (p. 3)

Random House, Inc. New York, New York, USA. 1963

Levi, Primo 1919–87
Italian writer and chemist

Twenty billion years before now,

Brilliant, soaring in space and time

There was a ball of flame, solitary, eternal,

Our common father and our executioner.

It exploded, and every change began.

Even now the thin echo of this one reverse catastrophe

Resounds from the furthest reaches.

Translated by Ruth Feldman and Brian Swann

Collected Poems

In the Beginning

Faber & Faber. Boston, Massachusetts, USA. 1988

MacRobert, Alan

Editor

The idea of an oscillating universe, in which the Big Bang resulted from the recollapse of a previous phase of the universe, gained currency merely because it avoided the issue of creation – not because there was the slightest evidence in favor of it.

Beyond the Big Bang

Sky & Telescope, Vols. 65–66, March, 1983 (p. 211)**Maddox, John Royden** 1925–

Welsh chemist and physicist

The microwave background radiation, which fills even the corners of the universe, would psychologically have been more compelling evidence for the Big Bang if it had been predicted before its discovery in 1965. That it was not is something of a surprise, which is nevertheless now irrelevant.

The Best Cosmology There Is

Nature, Volume 372, Number 6501, 3 November, 1994 (p. 15)**Mather, John C.** 1946–

American astrophysicist

“The Big Bang Theory comes out a winner. This is the ultimate in tracing one’s cosmic roots.” He added, “We are seeing the cold glow still remaining from the initially very hot Big Bang.... The closer we examine the Big Bang the simpler the picture gets.”

In P. Cleggett-Haleim

Big Bang Theory Passes Toughest Test

NASA Press Release, Washington, D.C., January 7, 1993**Parker, Barry**

Canadian physicist

If we accept the big bang theory, and most cosmologists now do, then a “creation” of some sort is forced upon us.

Creation: The Story of the Origin and Evolution of the Universe

Chapter 11 (p. 202)

Plenum Press. New York, New York, USA. 1998

Poe, Edgar Allan 1809–49

American short story writer

I am fully warranted in announcing that the Law which we have been in the habit of calling Gravity exists on account of Matter’s having being irradiated, at its origin, atomically, into a limited sphere of Space, from one, individual, unconditional, irrelative, and absolute Particle Proper, by the sole process in which it is possible to satisfy, at the same time, the two conditions, irradiation and generally equable distribution throughout the sphere, that is to say, by a force varying in direct proportion with the squares of the distances between the irradiated atoms, respectively, and the Particular centre of Irradiation.

Eureka

Line 8 (p. 67)

Geo. P. Putnam. New York, New York, USA. 1848

Silk, Joseph 1942–

American astronomer and physicist

It’s impossible that the Big Bang is wrong.

In Eric J. Lerner

The Big Bang Never Happened

Chapter 1 (p. 11)

Random House, Inc. New York, New York, USA. 1991

Smoot, George 1945–

American astrophysicist

What we have found is evidence for the birth of the universe.... It’s like looking at God.

In T.H. Maugh

Relics of “Big Bang” Seen for First Time

Los Angeles Times, April 24, 1992:A1**Turner, Michael S.**

American astrophysicist

The significance of this cannot be overstated. They have found the Holy Grail of cosmology.

American Scientists Find a “Holy Grail”

International Herald Tribune, London, April 24, 1992:1**Updike, John** 1932–

American novelist, short story writer, and poet

Space-time. Three spatial dimensions, plus time. It knots. It freezes. The seed of the universe has come into being. Out of nothing. Out of nothing and brute geometry, laws that can’t be otherwise, nobody handed them to Moses, nobody had to. Once you’ve got that little seed, that little itty-bitty mustard seed – ka-boom! Big Bang is right around the corner.

Roger’s Version

Chapter V (p. 303)

Alfred A. Knopf. New York, New York, USA. 1986

Weinberg, Steven 1933–

American nuclear physicist

In the beginning there was an explosion. Not an explosion like those familiar on earth, starting from a definite center and spreading out to engulf more and more of the circumambient air, but an explosion which occurred simultaneously everywhere, filling all space from the beginning, with every particle of matter rushing apart from every other particle.

The First Three Minutes

Chapter I (p. 5)

Basic Books, Inc., Publishers. New York, New York, USA. 1988

Weldon, Fay 1931–

English novelist

Who cares about half a second after the big bang; what about the half second before?

In Paul Davies

About Time: Einstein’s Unfinished Revolution

Header (p. 129)

Simon & Schuster. New York, New York, USA. 1995

Wheeler, John Archibald 1911–

American physicist and educator

Not only particles and the fields of force had to come into being at the big bang, but the laws of physics themselves, and this by a process as higgledy-piggledy as genetic mutation or the second law of thermodynamics.

The Computer and the Universe

International Journal of Theoretical Physics, Volume 21, Numbers 6/7, June 1982 (p. 565)

Zeldovich, Yakov Borisovich 1914–87

Russian physicist

The point of view of a sinner is that the church promises him hell in the future, but cosmology proves that the glowing hell was in the past.

In Joseph Silk

The Big Bang (p. 101)

W.H. Freeman. New York, New York, USA. 1989

BINARY**Author undetermined**

In the binary system we count on our fists instead of on our fingers.

Source undetermined

Laplace, Pierre Simon 1749–1827

French mathematician, astronomer, and physicist

It was thus that Liebnitz believed he saw the image of creation in his binary arithmetic where he employed only the two characters, unity and zero. He imagined, since God can be represented by unity and nothing by zero, that the Supreme Being had drawn from nothing all beings, as unity with zero expresses all the numbers in this system of arithmetic. This idea was so pleasing to Liebnitz that he communicated it to the Jesuit Grimaldi, president of the tribunal of mathematics in China, in the hope that this emblem of creation would convert to Christianity the emperor there who particularly loved the sciences.

Translated by Frederick Wilson Truscott and Frederick Lincoln

A Philosophical Essay on Probabilities

Chapter XVI (p. 169)

John Wiley & Sons. New York, New York, USA. 1902

BINOMIAL EXPANSION**Kaminsky, Kenneth**

American mathematics professor, writer, and editor

...yeah, our apartment was small. It was so small, we had to go out in the hall just to use the binomial expansion.

Professor Fogelfro

Mathematical Magazine, Volume 69, Number 2, April, 1996 (p. 142)**BINOMIAL THEOREM****Fabre, Jean-Henri** 1823–1915

French entomologist and author

And now we are together, O mysterious tome, whose Arab name breathes a strange mustiness of occult lore and claims kindred with the sciences of almagest and alchemy. What will you show me? Let us turn the leaves at random. Before fixing one's eyes on a definite point in the landscape, it is well to take a summary view of the whole. Page follows swiftly upon page, telling me nothing. A chapter catches my attention in the middle of the volume; it is headed, Newton's Binomial Theorem.

Translated by Alexander Teixeira de Mattos

The Life of the Fly

Chapter XII (p. 282)

Dodd, Mead & Co. New York, New York, USA. 1925

BIOCENTRIC**Taylor, Paul W.**

No biographical data available

To accept the biocentric outlook and regard ourselves and the world from its perspective is to see the whole natural domain of living things and their environment as an order of interconnected objects and events.

Respect for Nature: A Theory of Environmental Ethics

The Natural World As A System of Interdependence (p. 116)

Princeton University Press. Princeton, New Jersey, USA. 1986

BIOCHEMIST**Chargaff, Erwin** 1905–2002

Austrian biochemist

There are few things in the world before which the biochemist feels as uncomfortable as when he has to deal with life itself.

Voices in the Labyrinth: Nature, Man and Science (p. 73)

The Seabury Press. New York, New York, USA. 1977

BIOCHEMISTRY**Chantrenne, H.**

No biographical data available

Biochemistry is no longer the chemistry of death and decay; it is the chemistry of the living cell, with its essential irreversible, oriented processes admirably organized and controlled.

In Nathan O. Kaplan and Eugene P. Kennedy (eds.)

Current Aspects of Biochemical Energetics: Fritz Lipmann Dedicatory Volume

For the 25th Anniversary of ~ P (p. 37)

Academic Press. New York, New York, USA. 1966

Chargaff, Erwin 1905–2002

Austrian biochemist

...biochemistry is helpless before life, having to kill the organism before investigating it. Biochemistry is, in fact, much more successful in practicing the second part of its composite name than in following the prefix.

Triviality in Science: A Brief Meditation on Fashions

Perspectives in Biology and Medicine, Volume 19, Number 3, Spring, 1976 (p. 333)

What I liked about chemistry was its clarity surrounded by darkness; what attracted me, slowly and hesitatingly, to biology was its darkness surrounded by the brightness of the givenness of nature, the holiness of life. And so I have always oscillated between the brightness of reality and the darkness of the unknowable. When Pascal speaks of God in hiding, *Deus absconditus*, we hear not only the profound existential thinker, but also the great searcher for the reality of the world. I consider this unquenchable resonance as the greatest gift that can be bestowed on a naturalist.

Heraclitean Fire: Sketches from a Life before Nature

The Silence of the Heavens (p. 55)

Rockerfeller University Press. New York, New York, USA. 1978

Darling, David 1953–

Freelance science writer

Every human being, and every human mind, has roots that extend indefinitely far back through time. The genes that regulate all aspects of our physical development, including the prenatal fabrication of our brains, were in existence long before we or our parents were born. Those genes, in turn, evolved, step by step, from more primitive genetic material that can trace its ancestry back to the first biochemical reactions on Earth. And we do not have to stop there. We can carry the search for the ultimate origin of ourselves back still further – back to the very beginning of the universe.

Equations of Eternity: Speculations on Consciousness, Meaning, and the Mathematical Rules That Orchestrate the Cosmos

Chapter 2 (p. 22)

Hyperion. New York, New York, USA. 1993

Deutscher, Murray

No biographical data available

To dialyze, or not to dialyze – that is the question: –
Whether 'tis better for the protein to suffer

The wear and tear of defective Visking

Or to take the chances against a sea of buffers

By chromatography instead?

Biochemist's Soliloquy

Perspectives in Biology and Medicine, Volume VIII, Number 2, Winter 1965 (p. 277)

Fruton, Joseph S. 1912–

Polish-born American biochemist

Simmonds, Sophia

No biographical data available

The ultimate goal of biochemistry is to describe the phenomena that distinguish the “living” from the “non-living” in the language of chemistry and physics.

General Biochemistry (2nd edition)

Chapter 1 (p. 1)

John Wiley & Sons, Inc. New York, New York, USA. 1958

Hopkins, Frederick Gowland 1844–89

English biochemist

The task of the biochemist wishing to get to the heart of his problem is exceptional in that he must study systems in which the organization of chemical events counts for more, and is carried far beyond, such simpler coordinations as may be found in non-living systems. He would be over-bold were he to claim at present that such high organization can depend alone upon adjusted concentrations and ordered structural distributions among specialized colloidal catalysts, but he is justified, I think, in feeling sure that such factors contribute to that organization in a significant sense. The biochemist, when he aims at describing living systems in his own language, comes in contact with philosophical thought.... His may not be the last word in the description of life, but without his help the last word will never be said.

In Joseph Needham and Ernest Baldwin (eds.)

Hopkins & Biochemistry

Problems of Specificity in Biochemical Catalysis

33rd Robert Boyle Lecture, 1931 (p. 223)

W. Heffer & Sons Ltd. Cambridge, England. 1949

Meyerhof, Otto 1884–1951

German biochemist

Biochemistry has an important bearing on the progress of medicine. But because of this, it must itself remain a pure science, whose initiates are inspired by a craving for understanding and by nothing else.

Biochemistry

Scientific American, Volume 183, Number 3, September, 1950 (p. 68)

Ochoa, Severo 1905–93

Spanish biochemist and molecular biologist

In recent years biochemistry – the chemistry of life – has come more and more into the foreground of biological research. This is natural since chemical reactions are at the bottom of all life.

Les Prix Nobel. The Nobel Prizes in 1959

Nobel banquet speech for award received in 1959

Nobel Foundation. Stockholm, Sweden. 1960

Rose, Steven Peter Russell 1938–

No biographical data available

Biochemists are different from organic and natural-product chemists in a number of important ways. First,

for us the structure, sequence and molecular properties of substances derived from living organisms are not of great interest in their own right, but only insofar as they may be seen as providing information which casts light on the biological role of the substance.... Second...we are likely to be less interested in the properties of "pure" molecules in isolation, and more concerned with the ways in which they are involved in complex interactions with other molecules.

Reflections on Reductionism

Trends in Biochemical Sciences, Volume 13, 1988 (p. 161)

van Bergeijk, W. A.

No biographical data available

Biology implies biochemistry, but not the other way around.

In George Gaylord Simpson

Biology and Man

Chapter Two (p. 19)

Harcourt, Brace & World, Inc. New York, New York, USA. 1969

BIODIVERSITY

Terborgh, John 1936–

Tropical biologist

...to save biodiversity, we must act before the virgin forest disappears, because no effort at ecosystem rehabilitation, however sophisticated, will ever recreate nature in its primeval state.

Diversity and the Tropical Rain Forest

Chapter 9 (p. 232)

Scientific American Library. New York, New York, USA. 1992

Wilson, Edward O. 1929–

American biologist and writer

Biological diversity – "biodiversity" in the new parlance – is the key to the maintenance of the world as we know it. Life in a local site struck down by a passing storm springs back quickly because enough diversity still exists. Opportunistic species evolved for just such an occasion rush in to fill the spaces. They entrain the succession that circles back to something resembling the original state of the environment.

The Diversity of Life

Chapter One (p. 15)

W.W. Norton & Company, Inc. New York, New York, USA. 1992

The most wonderful mystery of life may well be the means by which it created so much diversity from so little physical matter.

The Diversity of Life

Chapter Four (p. 35)

Harvard University Press. Cambridge, Massachusetts, USA. 1992

We should judge every scrap of biodiversity as priceless while we learn to use it and come to understand what

it means to humanity. We should not knowingly allow any species or race to go extinct. And let us go beyond mere salvage to begin the restoration of natural environments in order to enlarge wild populations and stanch the hemorrhaging of biological wealth. There can be no purpose more enspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us.

The Diversity of Life

Chapter Fifteen (p. 351)

Harvard University Press. Cambridge, Massachusetts, USA. 1992

BIOGENESIS

Davies, Paul Charles William 1946–

British-born physicist, writer, and broadcaster

A law of nature of the sort we know and love will not create biological information, or indeed any information at all.... The secret of life lies, not in its chemical basis, but in the logical and informational rules it exploits.... Real progress with the mystery of biogenesis will be made, I believe, not through exotic chemistry, but from something conceptually new.

The Fifth Miracle: The Search for the Origin and Meaning of Life

Chapter 18 (pp. 210, 216)

Simon & Schuster. New York, New York, USA. 1999

BIOGEOGRAPHY

Darwin, Charles Robert 1809–82

English naturalist

In considering the distribution of organic beings over the face of the globe, the first great fact which strikes us is, that neither the similarity nor the dissimilarity of the inhabitants of various regions can be wholly accounted for by climatal and other physical conditions.

In *Great Books of the Western World* (Volume 49)

The Origin of Species by Means of Natural Selection

Chapter XII (p. 181)

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

A third great fact...is the affinity of the productions of the same continent or sea, though the species themselves are distinct at different points and stations. It is a law of the widest generality, and every continent offers innumerable instances. Nevertheless the naturalist in traveling, for instance, from north to south never fails to be struck by the manner in which successive groups of beings, specifically distinct, yet clearly related, replace each other.

In *Great Books of the Western World* (Volume 49)

The Origin of Species by Means of Natural Selection

Chapter XII (p. 182)

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Forbes, Edward 1815–54

English naturalist

Godwin-Austin, Robert Alfred Cloyne 1808–84
English geologist

Everyone knows that the same animals and plants are not found everywhere...but that they are distributed so as to be gathered in distinct zoological and botanical provinces, of greater or less extent, according to their degree of limitation by physical conditions, whether features of the earth's outline, or climate.

The Natural History of the European Seas

Chapter I (p. 1)

J. van Voorst. London, England. 1859

BIO-GEOLOGY

Kingsley, Charles 1819–75
English clergyman and author

Bio-geology, then, begins with asking every plant or animal you meet, large or small, not merely – What is your name? That is the collector and classifier's duty; and a most necessary duty it is, and one to be performed with the most conscientious patience and accuracy, so that a sound foundation may be built for future speculations. But young naturalists should act not merely as Nature's registrars and census-takers, but as her policemen and gamekeepers; and ask everything they meet – How did you get there? By what road did you come? What was your last place of abode? And now you are here, how do you get your living? Are you and your children thriving, like decent people who can take care of themselves, or growing pauperized and degraded, and dying out?

Scientific Essays and Lectures

On Bio-Geology (p. 3)

Publisher undetermined

BIOINFORMATICS

Spengler, Sylvia J.
American researcher in genetics

Perhaps bioinformatics – the shotgun marriage between biology and mathematics, computer science, and engineering – is like an elephant that occupies a large chair in the scientific living room.... There are probably many biologists who feel that a major product of this bioinformatics elephant is large piles of waste material.

Bioinformatics in the Information Age

Science, Volume 287, Number 5456, 18 February, 2000 (p. 1221)

BIOLOGICAL

Arber, Agnes Robertson 1879–1960
English botanist

Since the first step in biological research involves the decision as the question on which to concentrate, the researcher is at once put upon his mettle, for the full

recognition and appreciation of a problem may task him even more severely than its solution.

The Mind and the Eye: A Study of the Biologist's Standpoint

Chapter I (p. 6)

At the University Press. Cambridge, England, USA. 1954

Bernard, Claude 1813–78
French physiologist

If we mean to build up the biological sciences, and to study fruitfully the complex phenomena which occur in living beings, whether in the physiological or the pathological state, we must first of all lay down principles of experimentation, and then apply them to physiology, pathology and therapeutics.

Translated by Henry Copley Greene

An Introduction to the Study of Experimental Medicine

Introduction (p. 2)

Henry Schuman, Inc. New York, New York, USA. 1927

Bird, J. M.

No biographical data available

...we shall have to have a philosophy of biological life which gives the human animal something to survive with, a universe which gives us a place to survive into, and a covering of cosmic philosophy which recognizes all this as an aspect of reality. If the necessity arises it will be met and in that event we shall be able to say with obvious truth that science and religion have come together.

In Edward H. Cotton

Has Science Discovered God?

Chapter XVI (p. 293)

Thomas Y. Crowell Company, Publishers. New York, New York, USA. 1931

Brower, David 1912–2000
American environmentalist

A fallen tree supports a biological community that may be essential to the existence of the forest itself.

In Jonathan White

Talking on the Water: Conversations About Nature and Creativity

The Archdruid Himself (p. 41)

The Sierra Club. San Francisco, California, USA. 1994

Chargaff, Erwin 1905–2002
Austrian biochemist

An observer of our biological sciences today sees dark figures moving over a bridge of glass. We are faced with an ever expanding universe of light and darkness. The greater the circle of understanding becomes, the greater is the circumference of surrounding ignorance.

Essays on Nucleic Acids

Chapter 8 (p. 109)

Elsevier Publishing Company. Amsterdam. 1963

Comte, Auguste 1798–1857
French philosopher

If biological phenomena are incomparably more complex than those of any preceding science, the study of them

admits of the most extensive assemblage of intellectual means (many of them new) and develops human faculties hitherto inactive, or known only in a rudimentary state.

The Positive Philosophy of Auguste Comte (Volume 2)

Book V, Chapter I (p. 12)

George Bell & Sons. London, England. 1896

Dayton, P. K.

No biographical data available

Mordida, B. J.

No biographical data available

Geological history and oceanographic processes are the warp and woof of the biological understanding of any marine habitat.

Polar Marine Communities

American Zoologist, Volume 34, 1994 (p. 90)

Dunn, R. A.

No biographical data available

Davidson, R. A.

No biographical data available

Biologic categorization is one of the most conspicuous aspects of successful behavior, not only of man, but of all animals, in meeting the requirements for survival in a complex environment.

Pattern Recognition in Biological Classification

Pattern Recognition, Volume 1, 1968 (p. 75)

Durant, William James 1885–1981

American historian and essayist

So the first biological lesson of history is that life is competition. Competition is not only the life of trade, it is the trade of life – peaceful when food abounds, violent when the mouths outrun the food. Animals eat one another without qualm; civilized men consume one another by due process of law.

The Lessons of History

Chapter III (p. 19)

Simon & Schuster. New York, New York, USA. 1968

Handler, Philip 1917–81

American biochemist

Biology has become a mature science as it has become precise and quantifiable. The biologist is no less dependent upon his apparatus than the physicist.

Biology and the Future of Man

Chapter 1 (p. 6)

Oxford University Press, Inc. London, England. 1970

Loewy, A. G.

No biographical data available

Siekevitz, P.

No biographical data available

A dramatic demonstration of the importance of biological structure was provided by the experiments of Skoultchi

and Morowitz, who cooled the eggs of the brine shrimp *Artemia* to temperatures below 2 degrees K (–271 C) and showed that upon rewarming their hatch rate was the same as that of control eggs held at room temperature. Since at that temperature we have structure but presumably no process, it is reasonable to conclude that structure is not only a necessary condition, but even a sufficient condition for initiating biological function. It would thus appear that living processes could be generated by putting together the proper structures, the synthesis of life becoming “merely” a very complicated exercise in organic chemistry.

Cell Structure and Function

Chapter 4 (p. 33)

Holt, Rinehart & Wilson, Inc. New York, New York, USA. 1969

Mason, Otis T.

No biographical data available

To begin with activities that are purely biological, thoughts in common are shared with the animals. The revolution of the earth on its axis, producing day and night, causes nature to awaken in concert in the morning and to fall asleep in unison in the evening. There is no leader to the orchestra in the former, nor authoritative command or lullaby in the latter.

The Ripening of thoughts in Common

Proceedings of the American Philosophical Society, Volume XLIII,

April 9, 1904 (p. 149)

Pittendrigh, Colin S. 1918–96

English biologist

The study of adaptation is not an optional preoccupation with fascinating fragments of natural history, it is the core of biological study.

In A. Roe and G.G. Simpson (eds.)

Behavior and Evolution

Adaptation, Natural Selection, and Behavior (p. 395)

Yale University Press. New Haven, Connecticut, USA. 1958

Snyder, Gary 1930–

American poet, essayist, and environmental activist

We’re so impressed by our civilization and what it’s done, with our machines, that we have a difficult time recognizing that the biological world is infinitely more complex.

The Real Work

Tracking Down the Natural Man (p. 87)

New Directions Publishing Corporation. New York, New York, USA.

1980

Trivers, Robert 1943–

American biologist

I want to change the way people think about their everyday lives. How you think is going to affect who you marry, what kind of relationship you establish, whether and in what manner you reproduce. That’s day-to-day thinking, right? But they don’t even teach courses on that

stuff.... Life is intrinsically biological. It's absurd not to use our best biological concept.

In Roger Bingham

A Passion to Know: 20 Profiles in Science

Robert Trivers: Biologist of Behavior (p. 75)

Charles Scribner's Sons. New York, New York, USA. 1984

von Bunge, Gustav 1844–1920

Physiologist

I think that the more thoroughly and conscientiously we endeavor to study biological problems, the more we are convinced that even those processes which we have already regarded as explicable by chemical and physical laws are in reality infinitely more complex, and at present defy any attempt at a mechanical explanation.

Translated by Florance Starling

Text-book of Physiological and Pathological Chemistry (2nd edition)

Lecture I (p. 2)

P. Blackiston's Sons & Co. Philadelphia, Pennsylvania, USA. 1902

Wheeler, William Morton 1865–1937

American entomologist

And so far as the actual, fundamental, biological structure of our society is concerned and notwithstanding its stupendous growth in size and all the tinkering to which it has been subjected, we are still in much the same infantile stage. But if the ants are not despondent because they have failed to produce a new social invention or convention in 65 million years, why should we be discouraged because some of our institutions and castes have not been able to evolve a new idea in the past fifty centuries?

Social Life Among the Insects: Being a Series of Lectures Delivered at the Lowell Institute in Boston in March, 1922

Lecture I (pp. 8–9)

Harcourt, Brace & Company. New York, New York, USA. 1923

Wilson, Andrew 1852–1912

No biographical data available

Biological science, which was formerly regarded as closing its investigations when it approached the human domain, has now boldly entered the precincts of man's own and special order. In a sphere within which biology was formerly regarded as an intruder, it is now welcomed by the latest culture as a friend.

Leisure-time Studies, Chiefly Biological: A Series of Essays and Lectures

Chapter I (p. 1)

Chatto & Windus. London, England. 1898

Woodger, Joseph Henry 1894–1981

English biologist

If we make a general survey of biological science we find that it suffers from cleavages of a kind and to a degree which is unknown in such a well unified science as, for example, chemistry. Long ago it has undergone that inevitable process of subdivision into special branches which we find in other sciences, but in biology

this has been accompanied by a characteristic divergence of method and outlook between the exponents of the several branches which has tended to exaggerate their differences and has even led to certain traditional feuds between them. This process of fragmentation continues, and with it increases the time and labour requisite for obtaining a proper acquaintance with any particular branch.

Biological Principles: A Critical Study

General Introduction (p. 11)

Kegan Paul, Trench, Trubner & Company Ltd. London, England. 1929

Young, Michael Dunlop 1915–

English lawyer

Every bodily process is pulsing to its own beat within the overall beat of the solar system.

The Metronomic Society: Natural Rhythms and Human Timetables

Chapter Two (p. 20)

Harvard University Press. Cambridge, Massachusetts, USA. 1988

BIOLOGICAL MOLECULE

Gerstein, Mark

American physical and biological scientist

Levitt, Michael

No biographical data available

When scientists publish models of biological molecules in journals, they usually draw their models in bright colors and place them against a blank, black background. We now know that the background in which these molecules exist – water – is just as important as they are.

Simulating Water and the Molecules of Life

Scientific American, November, 1998 (p. 105)

BIOLOGICAL TEACHING

Patten, William 1861–1932

American biologist

Much of our biological teaching is like a shop window display of nature's competitive goods, with a varied assortment of human notions thrown in, but with no guarantee as to their significance, or quality, or usefulness.

The Grand Strategy of Evolution: The Social Philosophy of a Biologist

Appendix (p. 424)

Richard G. Badger. Boston, Massachusetts, USA. 1920

BIOLOGIST

Allee, Warder C. 1885–1955

American zoologist

Our tasks as biologists, and as citizens of a civilized country, is a practical engineering job. We need to help arrange so that the existing trend toward a workable world organization will be guided along practical lines

which accord with sound biological theory. And we must remember always that in such matters the idealist with the long-range view is frequently the true realist.

Where Angels Fear to Tread: A Contribution from General Sociology to Human Ethics

Science, Volume 97, 1943 (p. 517?)

Allen, Durward L. 1910–87

Wildlife biologist

The biologist has a term for the progress of the seasons; he calls it phenology. It becomes a matter of habit to interpret almost any observation in terms of what has happened and what is going to happen. The present is a moment in a sequence of changes. The basis of phenology is, of course, the climatic cycle through the year.

Wolves of Minong: Their Vital Role in a Wild Community

Chapter 7 (p. 142)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1979

Author undetermined

A group of goose biologists were meeting to brainstorm about the migration tactics of Canada geese. They were particularly interested in applying for a \$100,000 Federal grant to investigate the ‘V’ formation of goose flight. It had been observed that one side of the ‘V’ is always longer than the other side. This group would put together a research proposal to apply for the \$100,000 grant and hopefully find out why this happens.

To start off the discussion, Todd, the Consulting Firm Biologist stands up and says in typical consultant fashion, ‘I say we ask for \$200,000, and attempt to model the wind drag coefficients. We can have our geologists record and map the ground topography and then our staff meteorologists can predict potential updraft currents. Our internal CAD department can then produce 3D drawings of the predicted wing tip vortices. Then, after several years of study, our in-house publications department could produce a nice thick report full of charts and graphs.’

The Senior Research Biologist, a professor at the local university, cleared his throat and responded, ‘No, no!, That’s not it at all. We only need \$150,000. We can train a group of domesticated geese to fly in formations of equal length and then compare their relative fitness to wild geese. We can then publish the results in the Journal of Wildlife Management.

About then, the hardworking field biologist stands up and begins walking for the door. ‘Where are you going?’ the group asks. ‘I’m leaving’ he replies, ‘I’ve heard enough. No one has to give me \$100,000 to find out that the reason one side of the ‘V’ is longer is simply because there are more geese on that side!’

Source undetermined

Boyle, Robert 1627–91

English natural philosopher and theological writer

Great mathematicians are like fastball pitchers. They’re at their peak in their 20s, and after that they’re finished. Great chemists are like curveball or screwball pitchers. They make their contributions in their 30s. But great biologists are like knuckle-ball pitchers. They can go on for years because they don’t burn out. In fact, biologists get better with age.

Fisheries Biologist William Ricker is a Real Hall of Famer in His Field

Sports Illustrated, November 12, 1984 (p. 129)

Connolly, Cyril 1903–74

English critic and editor

The answer seems to rest with three categories of thinkers; the physicists, who incline to believe in God, but are now all busy making explosives; the biologists and chemists who can produce almost everything except life, and who, if they could create life, would prove that it might have arisen accidentally; and the psychologists and physiologists, who are struggling to discover the relation of mind to brain, the nature of consciousness.

The Unquiet Grave

Part III (p. 80)

Hamish Hamilton. London, England. 1945

Cudmore, Lorraine Lee

American cell biologist

All cell biologists are condemned to suffer an incurable secret sorrow: the size of the objects of their passion.

The Center of Life: A Natural History of the Cell

The Universal Cell (p. 5)

New York Times Book Company. New York, New York, USA. 1977

We are a sad lot, the cell biologist. Like the furtive collectors of stolen art, we are forced to be lonely admitters of spectacular architecture, exquisite symmetry, dramas of violence and death, nobility, self-sacrifice and yes, rococo sex.

The Center of Life: A Natural History of the Cell

The Universal Cell (p. 6)

New York Times Book Company. New York, New York, USA. 1977

Darbshire, Arthur Dukinfield 1879–1915

Statistician

The cocksureness of the scientific biologist should surely be the cause of the gravest misgivings. The more certain a man is that he is right the more probable is it that he is wrong; because it means that facts are as soft clay in his hands, and his certainty moulds them to his purpose.

An Introduction to a Biology

Chapter I (p. 32)

Funk & Wagnalls Co. New York, New York, USA. 1917

Those who prefer swimming out of their depth may speculate upon first causes and on what happens after death. But the biologist, whose business is the difficult task of understanding life, must be careful to undertake a much less ambitious and precarious task.

An Introduction to a Biology

Appendix to an Introduction to Biology (p. 105)

Funk & Wagnalls Co. New York, New York, USA. 1917

Dawkins, Richard 1941–

English ethologist, evolutionary biologist, and popular science writer

The physicist's problem is the problem of ultimate origins and ultimate natural laws. The biologist's problem is the problem of complexity.

The Blind Watchmaker

Chapter 1 (p. 15)

W.W. Norton & Company, Inc. New York, New York, USA. 1986

Eve, A. S.

No biographical data available

Biologists are divided into three camps, vitalists, mechanists, and those who sit on the boundary fence.

Annual Report of the Board of Regents of the Smithsonian Institution, 1914

Modern Views on the Constitution of the Atom (p. 183)

Government Printing Office. Washington, D.C. 1915

Flannery, Maura C.

American biologist

The patterns and rhythms of nature, science as a search for order, form as a central problem in biology, are themes that are rarely emphasized in research reports and in texts, they are nevertheless powerful concepts that direct and inform biologists' work.

Biology Is Beautiful

Perspectives in Biology and Medicine, Volume 35, Number 3, Spring 1992 (p. 427)

Hull, David L. 1935–

American philosopher of biology

Evolutionary biologists are currently confronted by a... dilemma: If they insist on formulating evolutionary theory in terms of commonsense entities, the resulting laws are likely to remain extremely variable and complicated; if they want simple laws, equally applicable to all entities of a particular sort, they must abandon their traditional ontology. This reconceptualization of the evolutionary processes is certainly counter-intuitive; its only justification is the increased scope, consistency, and power of the theory that results.

Individuality and Selection

Annual Review of Ecology and Systematics, Volume 11, 1980 (pp. 316–317)

Huxley, Julian 1887–1975

English biologist, philosopher, and writer

“Know me, know my frog” – that is, I think, a legitimate adaptation of the old proverb for the biologist.

Essays in Popular Science

The Frog and Biology (p. 189)

Chatto & Windus. London, England. 1926

Huxley, Thomas Henry 1825–95

English biologist

I do not question for a moment, that while the Mathematician is busied with deductions from general propositions, the Biologist is more especially occupied with observations, comparisons, and those processes which lead to general propositions.

Lay Sermons, Addresses, and Views

On the Educational Value of the Natural History Sciences (p. 87)

New York, New York, USA. 1872

The Biologist deals with a vast number of properties of objects, and his inductions will not be completed, I fear, for ages to come; but when they are, his science will be as deductive and as exact as the Mathematics themselves.

Lay Sermons, Addresses and Reviews

Chapter V (p. 87)

D. Appleton & Co. New York, New York, USA. 1903

Kellogg, Vernon Lyman 1867–1937

American zoologist

...the biologist seems unable to escape from the use of a terminology that is to be found in the larger dictionaries – and these dictionaries are at home, while the public is in the lecture-hall.

The Biologist Speaks of Death

The Atlantic Monthly, June, 1921 (p. 778)

Loeb, Jacques 1859–1924

German physiologist

...the investigations of the biologist differ from those of the chemist and physicist in that the biologist deals with the analysis of the mechanism of a special class of machines. Living organisms are chemical machines, made of essentially colloidal material which possess the peculiarity of developing, preserving and reproducing themselves automatically. The machines ... have thus far been reproducing themselves, though no one can say with certainty that such machines might not one day be constructed artificially.

The Recent Development of Biology, I

Science, Volume 20, Number 519, December 9, 1904 (p. 778)

Martin, Charles-Noël 1923–

French physicist

Despite the vast number of facts he has at his fingertips, the modern biologist still knows next to nothing about life itself, its origins, or its workings.

Translated by A.J. Pomerans

The Role of Perception in Science

Chapter 4 (p. 76)

Hutchinson of London. London, England. 1963

Medawar, Sir Peter Brian 1915–87

Brazilian-born English zoologist

Biologists work very close to the frontier between bewilderment and understanding. Biology is complex, messy and richly various, like real life; it travels faster nowadays than physics or chemistry (which is just as well, because it has so much farther to go), and it travels nearer to the ground.

Pluto's Republic

Induction and Intuition in Scientific Thought (p. 73)

Oxford University Press, Inc. Oxford, England. 1982

Pearson, Will

American speaker

Molecular biologists are like mechanics at a small-town garage – drive in any model of vehicle and they want to pop the hood to see what makes it run. Microbiologists are like dealership mechanics, working only on certain makes.

In Will Pearson, Mangesh Hattikudur and Elizabeth Hunt

Mental Floss Presents Condensed Knowledge

Condensed Biology (p. 38)

HarperCollins. New York, New York, USA. 2004

Peattie, Donald Culross 1898–1964

American botanist, naturalist, and author

...the more anyone knows about the two kingdoms, animate and vegetating, the less he perceives any boundary between them, until finally he comes to deny the existence of that boundary. Holding the passport of investigation which is stamped with the one great seal of life itself, a biologist travels unchallenged from one realm to the other.

Flowering Earth

Chapter 4

G.P. Putnam's Sons. New York, New York, USA. 1939

Reiger, George 1939–

American writer

Biologists are like engineers in imagining they can fine-tune the workings of nature. Such fine-tuning, however, only works in computer models.

The Striped Bass Chronicles: The Saga of America's Great Game Fish

Chapter 9 (p. 108)

Lyons Press. Guilford, Connecticut, USA. 2006

Rota, Gian-Carlo 1932–99

Italian-born American mathematician

Biologists seldom have the mathematical view that is required to spot problems in the mathematics of biology that are staring at them. A biologist will never see anything deeper than binomial coefficients. It is not that the problems aren't there; rather, biologists don't have the view that comes with a solid education in mathematics.

Indiscrete Thoughts

Chapter XX (p. 213)

Birkhäuser. Boston, Massachusetts, USA. 1997

Salter, William T.

No biographical data available

As he picks up his beautiful new tool...it is well for the modern biologist to remind himself how subtly and completely a fascination for gadgets can betray sound sense.

A Background for Biological Studies with Radioiodine

Science, Volume 109, Number 2836, May 6, 1949 (p. 454)**Salthe, Stanley N.**

American biologist

...we are, as evolutionary biologists, indirectly working on nothing less than an important part of our culture's very own creation myth. Is the combination of the pointlessness of chance with the tyranny of necessity, competitive exclusion, expedience, and obedience to material forces what we really want to think of as the sources of our origins.

In Max K. Hecht (ed.)

Evolutionary Biology at the Crossroads

Commentaries (p. 175)

Queens College Press. Flushing, New York, USA. 1989

Shaw, George Bernard 1856–1950

Irish comic dramatist and literary critic

I have no powder, no bottle, no tabloid. I am not a quack: I am a biologist.

Back to Methuselah

Part II, XXXIII (p. 84)

Constable & Company Ltd. London, England. 1921

Simpson, George Gaylord 1902–84

American paleontologist

When bright young biologists speak of genetics without genes and wise old biologists of life without organisms it is evident that something peculiar is going on in the science of biology, so peculiar that "crisis" is not too strong a word. I would diagnose this as combining monomania and schizophrenia.

Biology and Man

Chapter One (p. 3)

Harcourt, Brace & World, Inc. New York, New York, USA. 1969

Standen, Anthony

Anglo-American science writer

...since biologists deal constantly in analogies, they are easily misled by them.

Science Is a Sacred Cow

Chapter IV (p. 113)

E.P. Dutton. New York, New York, USA. 1950

A biologist, if he wishes to know how many toes a cat has, does not "frame the hypothesis that the number of feline digital extremities is 4, or 5, or 6," he simply looks at a cat and counts.

Science Is a Sacred Cow

Chapter VI (p. 151)

E.P. Dutton. New York, New York, USA. 1950

Steinbeck, John 1902–68
American novelist

We sat on crates of oranges and thought what good men most biologists are, the tenors of the scientific world – temperamental, moody, lecherous, loud laughing and healthy.... Your true biologist will sing you a song as loud and off-key as will a blacksmith, for he knows that morals are too often diagnostic of prostatitis and stomach ulcers. Sometimes he may proliferate a little too much in all directions, but he is as easy to kill as any other organism, and meanwhile he is very good company, and at least he does not confuse a low hormone productivity with moral ethics.

Sea of Cortez

Chapter 4 (p. 28–29)

Paul P. Appel, Publisher. Mount Vernon, New York, USA. 1982

Stockbridge, Frank B.

No biographical data available

A little bit of this, a little more of that, a pinch of something else, boil blank minutes, and set aside in the same vessel – thus might read the biologists' formula for creating life...

Creating Life in the Laboratory

Cosmopolitan, Volume 52, May, 1912 (p. 775)

Thomson, Sir John Arthur 1861–1933

Scottish naturalist

The world is like a change-office, without increase or decrease in its initial stock. We always stand in the middle of an equation, past equalling future. It is for the biologist to correct this partial view, for to him the possible that grows out of the past is new and in some measure unpredictable.

The System of Animate Nature: The Gifford Lectures Delivered in the University of St. Andrews in the Years 1915 and 1916 Volume 2

Lecture XI (p. 358)

Henry Holt & Co. New York, New York, USA. 1920

Vogel, Steven 1940–

American biologist

With the ratification of long tradition, the biologist goes forth, thermometer in hand, and measures the effects of temperature on every parameter of life. Lack of sophistication poses no barrier; heat storage and exchange may be ignored or Arrhenius abused; but temperature is, after time, our favorite abscissa. One doesn't have to be a card-carrying thermodynamicist to wield a thermometer.

Life in Moving Fluids: The Physical Biology of Flow

Chapter 1 (p. 1)

W. Grant Press. Boston, Massachusetts, USA. 1981

Waddington, Conrad Hal 1905–75

Developmental biologist and paleontologist

And, after all, I am a biologist; it is plants and animals that I'm interested in, not clever exercises in algebra or even chemistry.

Towards a Theoretical Biology: An IUBS Symposium (p. 81)

Aldine Publishing Co. Chicago, Illinois, USA. 1968

Weisz, Paul B. 1919–

German-born American chemical engineer and biomedical researcher

Man probably was a biologist before he was anything else. His own body in health and disease; the phenomenon of birth, growth and death; and the plants and other animals which gave him food, shelter, and clothing undoubtedly were matters of serious concern to even the first of his kind.

Elements of Biology (p. 13)

McGraw-Hill Book Company, Inc. New York, New York, USA. 1981

Wilson, Edmund Beecher 1856–1939

American zoologist

Perhaps it is not amiss to remark that the biologist may not hope to solve the ultimate problems of life any more than the chemist and physicist may hope to penetrate the final mysteries of existence in the non-living world.

Lectures on Science, Philosophy and Art, 1907–1908

Biology (p. 5)

The Columbia University Press. New York, New York, USA. 1908

Wilson, Edward O. 1929–

American biologist and writer

The role of science, like that of art, is to blend proximate imagery with more distant meaning, the parts we already understand with those given as new into larger patterns that are coherent enough to be acceptable as truth. Biologists know this relation by intuition during the course of fieldwork, as they struggle to make order out of the infinitely varying patterns of nature.

In Search of Nature

The Bird of Paradise: The Hunter and the Poet (p. 129)

Island Press. Washington, D.C. 1996

Zinsser, Hans 1878–1940

U.S. bacteriologist

Nature sets the conditions under which the biologist works, and he must accept her terms or give up the task altogether.

Rats, Lice and History

Chapter II (p. 15)

Little, Brown & Co. Boston, Massachusetts, USA. 1963

BIOLOGIST, MOLECULAR

Zack, Michael H.

The situation [copying to a short stretch of the long message coded in DNA] for a molecular biologist is like that

of a spy who knows that there was a paragraph in a vital document that started with “sometimes a...” “and ends with”...originally planned”. The spy knows the document has been mixed with millions of other documents and refuse at the local dump. The goal is to read the paragraph.

Knowledge and Strategy

Part Two, Chapter 5 (p. 76)

Butterworth-Heinemann. Boston, Massachusetts, USA. 1999

BIOLOGY

Abbey, Edward 1927–89

American environmentalist and nature writer

The basic science is not physics or mathematics but biology – the study of life. We must learn to think both logically and bio-logically.

A Voice Crying in the Wilderness: Notes from a Secret Journal

Chapter 10 (p. 94)

St. Martin's Press. New York, New York, USA. 1989

Author undetermined

Biology is the only science in which multiplication means the same thing as division.

Source undetermined

Biology is really Chemistry, Chemistry is really Physics, Physics is really Mathematics, and Mathematics is really Philosophy.

Source undetermined

Bartlett, Elisha 1804–55

American physician

With certain limited exceptions, the laws of physical science are positive and absolute, both in their aggregate, and in their elements, – in their sum, and in their details; but the ascertainable laws of the science of life are approximative only, and not absolute.

An Essay on the Philosophy of Medical Science

Part II, Chapter 11

Lea & Blanchard. Philadelphia, Pennsylvania, USA. 1844

Bates, Marston 1906–74

American zoologist

Natural history is not equivalent to biology. Biology is the study of life. Natural history is the study of animals and plants – of organisms. Biology thus includes natural history, and much else besides.

The Nature of Natural History

Chapter 1 (p. 7)

Scribner. New York, New York, USA. 1950

Berlinski, David 1942–

American mathematician

Mathematical sciences require *theories*, molecular biology *facts*.

A Tour of Calculus

Chapter 26 (p. 306)

Pantheon Books. New York, New York, USA. 1995

Bernard, Claude 1813–78

French physiologist

...the science of vital phenomena must have the same foundations as the science of phenomena of inorganic bodies, and...there is no difference in this respect between the principles of biological science and those of physico-chemical science.

Translated by Henry C. Greene

An Introduction to the Study of Experimental Medicine

Chapter III

Henry Schuman, Inc. New York, New York, USA. 1927

Burroughs, John 1837–1921

American naturalist and essayist

at their everlasting tasks, but biology is as a flower that cometh in a day and on the morrow is cut down.

Under the Apple Tree

The Primal Mind (p. 129)

Houghton Mifflin Co. Boston, Massachusetts, USA. 1916

Capra, Fritjof 1939–

Austrian-born American physicist

The exploration of the atom has forced physicists to revise their basic concepts about the nature of physical reality in a radical way. The result of the revision is a coherent dynamic theory, quantum mechanics, which transcends the principal concepts of Cartesian-Newtonian science. In biology, on the other hand, the exploration of the gene has not led to a comparable revision of basic concepts, nor has it resulted in a universal dynamic theory.

The Turning Point: Science, Society, and the Rising Culture

Chapter 4 (p. 121)

Simon & Schuster. New York, New York, USA. 1982

Carson, Rachel 1907–64

American marine biologist and author

I like to define biology as the history of the earth and all its life – past, present, and future. To understand biology is to understand that all life is linked to the earth from which it came; it is to understand that the stream of life, flowing out of the dim past into the uncertain future, is in reality a unified force, though composed of an infinite number and variety of separate lives....

Humane Biology Projects

Introduction

Animal Welfare Institute. Washington, D.C. 1977

Any concept of biology is not only sterile and profitless, it is distorted and untrue, if it puts its primary focus on unnatural conditions rather than on those vast forces not

of man's making that shape and channel the nature and direction of life.

Humane Biology Projects

Introduction

Animal Welfare Institute. Washington, D.C. 1977

Chargaff, Erwin 1905–2002

Austrian biochemist

In the old times, the knowledge of biology was perhaps similar to what could be made out in a very large, very dark house. Many objects could be more felt than seen with equal dimness, once the eyes got used to the darkness; and scientists were conscious of the limiting conditions under which they worked. In our time, however, a few very powerful and very narrow beams of light have been thrown into a few corners of this dark house, and several things can be seen in clarity and illumination that almost distort their significance. But at the same time we have lost our dark-adaptation; and since we all have a tendency to follow the light, we have moved into these cozy corners, to the detriment of the rest, which still is, by far, the major part of nature. In pointing this out one runs the risk of being accused of trying to spread the darkness.

Essays on Nucleic Acids

Chapter 3 (pp. 39–40)

Elsevier Publishing Company. Amsterdam, Netherlands. 1963

In no other science[than biology] is the span so wide between what it ought to understand and what it can understand.

Heraclitean Fire: Sketches from a Life before Nature (p. 163)

The Rockefeller University Press. New York, New York, USA. 1978

Cohen, Joel

No biographical data available

Physics-envy is the curse of biology.

Mathematics as Metaphor

Science, Volume 172, May, 1971 (p. 675)

Comte, Auguste 1798–1857

French philosopher

The time however has arrived when biology must, like the other sciences, make a fresh start in a purely speculative direction, free from all entanglement with medical or any other art.

The Positive Philosophy of Auguste Comte (Volume 2)

Book V, Chapter I (pp. 4–5)

George Bell & Sons. London, England. 1896

Conklin, Edwin Grant 1863–1952

American zoologist

The teachings of biology and of human history indicate that further social progress must lie in the direction of the rational coöperation of all mankind.

The Direction of Human Evolution Volume 2

Evolution And Democracy (p. 142)

Charles Scribner's Sons. New York, New York, USA. 1922

Conn, Herbert William 1859–1917

Biologist

Biology is often described as the most recent of the sciences, despite the fact that it was one of the first to be studied.

Biology: An Introductory Study for Use in Colleges

Chapter I (p. 1)

Silver, Burdett & Co. Boston, Massachusetts, USA. 1912

Crick, Francis Harry Compton 1916–2004

English biochemist

The development of biology is going to destroy to some extent our traditional grounds for ethical belief, and it is not easy to see what to put in their place.

Thinking About the Brain

Scientific American, Volume 241, Number 3, September, 1979 (p. 185)

The ultimate aim of the modern movement in biology is in fact to explain all biology in terms of physics and chemistry.

Of Molecules and Men

The Nature of Vitalism (p. 10)

University of Washington Press. Seattle, Washington, USA. 1966

Darbshire, Arthur Dukinfield 1879–1915

Statistician

The function of biology, if we adopt the literal, etymological meaning of the word, is to describe and interpret the essential manifestations of life, and to extract from these interpretations a conception, or theory, of life. But the word “biology” has come to be used in certain very much restricted senses, of which it will suffice to mention two. In its commonest signification it merely serves as a convenient common term for the subject matter of both botany and zoology. Another common meaning of it is the study of the habits of a particular animal or plant.

An Introduction to a Biology

Chapter I (pp. 1–2)

Funk & Wagnalls Co. New York, New York, USA. 1917

Dawkins, Richard 1941–

English ethologist, evolutionary biologist, and popular science writer

What lies at the heart of every living thing is not a fire, not warm breath, not a “spark of life.” It is information, words, instructions. If you want a metaphor, don't think of fires and sparks and breath. Think, instead, of a billion discrete, digital characters carved in tablets of crystal. If you want to understand life, don't think about vibrant, throbbing gels and oozes, think about information technology.

The Blind Watchmaker

Chapter 5 (p. 112)

W.W. Norton & Company, Inc. New York, New York, USA. 1986

Biology is the study of the complex things in the Universe. Physics is the study of the simple ones.

The Necessity of Darwinism

New Scientist, Volume 94, Number 1301, 15 April 1982 (p. 130)

But, however many ways there may be of being alive, it is certain that there are vastly more ways of being dead, or rather not alive.

The Blind Watchmaker

Chapter 1 (p. 9)

W.W. Norton & Company, Inc. New York, New York, USA. 1986

Dobzhansky, Theodosius 1900–75

Russian-American scientist

Seen in the light of evolution, biology is, perhaps, intellectually the most satisfying and inspiring science. Without that light it becomes a pile of sundry facts – some of them interesting or curious but making no meaningful picture as a whole.

In J. Peter Zetterberg (ed.)

Evolution versus Creationism: The Public Education Controversy

Nothing in Biology Make Sense Except in the Light of Evolution (p. 18)

Oryx Press, Phoenix, Arizona, USA. 1983

Driesch, Hans 1867–41

German biologist and philosopher

The analysis of the Aristotelian theory of life must therefore be one of the corner-stones of any historical works on biology.

The History & Theory of Vitalism

Chapter I (p. 11)

Macmillan & Company. London, England. 1914

Dwyer, Herbert A.

No biographical data available

If biology is the science of life and all its manifestations then some coordinating principle should have been derived, long ago, between the existing facts so that they would be helpful to the youth of the nation.

The American Biology Teacher, Volume 1, Number 1, October, 1938 (p. 22)

Emmeche, Claus 1956–

Danish theoretical biologist

Biology belongs to one of the surprising sciences, where each rule must always be supplemented with several exceptions (except this rule, of course).

Translated by Steven Sampson

The Garden in the Machine: The Emerging Science of Artificial Life

Chapter Six (p. 144)

Princeton University Press. Princeton, New Jersey, USA. 1994

Fauset, Jessie Redmon 1884–1961

American writer

Biology transcends society!

The Chinaberry Tree: A Novel of American Life

Chapter XIX (p. 121)

Negro University Press. New York, New York, USA. 1931

Freud, Sigmund 1856–1939

Austrian neurologist and co-founder of psychoanalysis

Biology is truly a land of unlimited possibilities; we may have the most surprising revelations to expect from it,

and cannot conjecture what answers it will offer in some decades to the questions we have put to it. Perhaps they may be such as to overthrow the whole artificial structure of hypotheses.

Translated by James Strachey

Beyond the Pleasure Principle

Chapter VI (p. 54)

W.W. Norton & Company, Inc. New York, New York, USA. 1961

Goodwin, Brian Carey 1931–

Canadian mathematician and biologist

The discovery of appropriate variables for biology is itself an act of creation.

In C.H. Waddington (ed.)

Towards a Theoretical Biology: An IUBS Symposium (Volume 2)

Appendix notes on the second symposium (p. 337)

Aldine Publishing Company. Chicago, Illinois, USA. 1968

A biology of parts becomes a medicine of spare parts and organisms become aggregates of genetic and molecular bits with which we can tinker as we please.... This is the path of ecological and social destruction.

How the Leopard Changed Its Spots

Chapter 7 (p. 215)

Phoenix Giant Paperback. London, England. 1994

Gore, Rick

American science and nature journalist

If anything illustrates what has happened in biology, it is this profound new ability to take the very stuff of life out of a cell, to isolate it in a test tube, to dissect it, and to probe the deep mysteries borne in its fragments.

The Awesome Worlds Within a Cell

National Geographic, Volume 150, Number 3, September, 1976 (p. 355)

Grassé, Pierre P. 1895–1985

French zoologist

Biology, despite the brilliance of its appearance, stammers in the presence of the essentials. We know neither all the properties of living matter, nor all of its astonishing possibilities.

In Joseph Wood Krutch

The Great Chain of Life

Chapter 11 (p. 192)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1957

Haldane, John Burdon Sanderson 1892–1964

English biologist

If physics and biology one day meet, and one of the two is swallowed up, that one will not be biology.

In J. Needham

Time: The Refreshing River

A Biologist's View of Whitehead's Philosophy (p. 204)

The Macmillan Company. New York, New York, USA. 1943

Hoyle, Sir Fred 1915–2001

English mathematician, astronomer, and writer

From the standpoint of biology, our presence on the Earth depends on a remarkable and even fantastic sequence of

chemical processes. From the standpoint of physics, the very material of which we are constituted has experienced an evolution scarcely less remarkable.

Ten Faces of the Universe

The Astrophysicist's Universe (p. 79)

W.H. Freeman & Company, San Francisco, California, USA. 1977

I wouldn't go into biology if I were starting again now. In twenty years' time it is the biologists who will be working behind barbed wire.

In G. Rattray Taylor

The Biological Time Bomb

Chapter I (p. 17)

The World Publishing Company, New York, New York, USA. 1968

Huxley, Aldous 1894–1963

English writer and critic

Solved by standard Gammas, unvarying Deltas, uniform Epsilons. Millions of identical twins. The principle of mass production at last applied to biology.

Brave New World

Chapter One (pp. 6–7)

Harper & Brothers, New York, New York, USA. 1950

Huxley, Thomas Henry 1825–95

English biologist

In the first place it is said – and I take this point first, because the imputation is too frequently admitted by Physiologists themselves – that Biology differs from the Physico-chemical and Mathematical sciences in being “inexact”.

Lay Sermons, Addresses, and Reviews

On the Educational Value of the Natural History Sciences (pp. 78–79)

New York, New York, USA. 1872

Judson, Horace

Science historian

Biology has proceeded not by great set-piece battles, but by multiple small-scale encounters – guerrilla actions – across the landscape. In biology, no large-scale, closely interlocking, fully worked out, ruling set of ideas has ever been overthrown.... Revolution in biology, from the beginnings of biochemistry and the study of cells, and surely in the rise of molecular biology and on to the present day, has taken place not by overturnings but by openings-up.

The Eighth Day of Creation: Makers of the Revolution in Biology

Afterword (p. 612)

Simon & Schuster, New York, New York, USA. 1979

Kac, Mark 1914–84

Polish mathematician

Rota, Gian-Carlo 1932–99

Italian-born American mathematician

Schwartz, Jacob T. 1930–

American mathematician and

The lack of real contact between mathematics and biology is either a tragedy, a scandal, or a challenge, it is hard to decide which.

Discrete Thoughts: Essays on Mathematics, Science, and Philosophy

Chapter One (p. 2)

Springer-Verlag, New York, New York, USA. 1992

Kauffman, Stuart A. 1939–

Theoretical biologist

If biologists have ignored self-organization, it is not because self-ordering is not pervasive and profound. It is because we biologists have yet to understand how to think about systems governed simultaneously by two sources of order. Yet who seeing the snowflake, who seeing simple lipid molecules cast adrift in water forming themselves into cell-like hollow lipid vesicles, who seeing the potential for the crystallization of life in swarms of reacting molecules, who seeing the stunning order for free in networks linking tens upon tens of thousands of variables, can fail to entertain a central thought: if ever we are to attain a final theory in biology, we will surely, surely have to understand the commingling of self-organization and selection. We will have to see that we are the natural expressions of a deeper order. Ultimately, we will discover in our creation myth that we are expected after all.

At Home in the Universe: The Search for Laws of Complexity

Chapter 5 (p. 112)

Oxford University Press, Inc. New York, New York, USA. 1995

Lamarck, Jean-Baptiste Pierre Antoine 1744–1829

French biologist

A sound Physics of the Earth should include all the primary considerations of the earth's atmosphere, of the characteristics and continual changes of the earth's external crust, and finally of the origin and development of living organisms. These considerations naturally divide the physics of the earth into three essential parts, the first being a theory of the atmosphere, or Meteorology, the second a theory of the earth's external crust, or Hydrogeology, and the third a theory of living organisms, or Biology.

Translated by Albert V. Carozzi

Hydrogeology

Forward (p. 18)

University of Illinois Press, Urbana, Illinois, USA. 1964

Lapworth, Charles 1842–1920

English geologist

Biology is pre-eminent today among the natural sciences, because its younger sister, Geology, gave it the means.

Report of the British Association for the Advancement of Science (1892)

Presidential Address to the Geology Section (p. 696)

Lorenz, Konrad 1903–89

Austrian zoologist

There are no good biologists whose vocation was not born of deep joy in the beauties of living nature.

In Jean Rostand

Translated by Lowell Bair

Humanly Possible: A Biologist's Note on the Future of Mankind

A Biologist's Mail (p. 20)

Saturday Review Press. New York, New York, USA. 1970

Lovelock, James Ephraim 1919–

English scientist

The successes of molecular biology are so beguiling that we forget the organism and its physiology. Schrödinger's disciples, who founded the church of molecular biology, have turned his wisdom into the dogma that life is self-replicating and corrects its errors by natural selection. There is much more to life than this naïve truth, just as there is more to the Universe than atoms alone – grandmothers live and enjoy the shade of Lombardy poplar trees not knowing that they and the trees are deemed by this dogma to be dead.

Living Alternatives

Nature, Volume 320, Number 6063, 17 April, 1986 (p. 646)

Mayr, Ernst 1904–2005

German-born American biologist

There is more to biology than rats, *Drosophila*, *Caenorhabditis*, and *E. coli*.

In Lynn Margulis and Dorion Sagan

Acquiring Genomes: A Theory of the Origins of Species

Forward (p. xiv)

Basic Books, Inc. New York, New York, USA. 2002

Biology was referred to as a “dirty science,” an activity, according to the physicist Ernest Rutherford, not much better than “postage stamp collecting.” At best it was a second-class, “provincial” science.

Toward a New Philosophy of Biology: Observations of an Evolutionist

Is Biology an Autonomous Science? (p. 9)

Harvard University Press. Cambridge, Massachusetts, USA. 1988

Medawar, Sir Peter Brian 1915–87

Brazilian-born English zoologist

If the task of scientific methodology is to piece together an account of what scientists actually do, the testimony of biologists should be heard with specially close attention. Biologists work very close to the frontier between bewilderment and understanding. Biology is complex, messy and richly various, like real life; it travels faster nowadays than physics or chemistry (which is just as well, since it has so much farther to go) and it travels nearer to the ground. It should therefore give us a specially direct and immediate insight into science in the making.

Induction and Intuition in Scientific Thought

Chapter I, Section 1 (p. 1)

American Philosophical Society. Philadelphia, Pennsylvania, USA. 1969

Monod, Jacques 1910–76

French biochemist

Biology occupies a position among the sciences at once marginal and central. Marginal because – the living world constituting but a tiny and very “special” part of the universe – it does not seem likely that the study of living beings will ever uncover general laws applicable outside the biosphere. But if the ultimate aim of the whole of science is indeed, as I believe, to clarify man's relationship to the universe, then biology must be accorded a central position since of all disciplines it is the one that endeavors to go most directly to the heart of the problems that must be resolved before that of “human nature” can be framed in other than metaphysical terms.

Translated by Austryn Wainhouse

Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology

Preface (p. xi)

Vintage Books. New York, New York, USA. 1972

Morrison, David

No biographical data available

Astrobiology is the scientific study of the origin, distribution, and future of life in the universe.

In J. Kelly Beatty, Carolyn Collins Petersen and Andrew Chaikin

The New Solar System (4th edition)

Exploring the Solar System (p. 12)

Cambridge University Press. Cambridge, England. 1999

Needham, James G. 1868–1957

American entomologist

It is a monstrous abuse of the science of biology to teach it only in the laboratory.... Life belongs in the fields, in the ponds, on the mountains and by the seashore.

In Allen H. Benton and William E. Werner

Field Biology and Ecology (p. 3)

McGraw-Hill Book Company, Inc. New York, New York, USA. 1966

Olson, Steve 1956–

American science writer

Biology is not just the science of what we are and how we came to be – it is also the science of what we can become.

Shaping the Future: Biology and Human Values

Afterword (p. 110)

National Academy Press. Washington, D.C. 1989

Osler, Sir William 1849–1919

Canadian physician and professor of medicine

Biology touches the problems of life at every point, and may claim, as no other science, completeness of view and a comprehensiveness which pertains to it alone. To all those whose daily work lies in her manifestations

the value of a deep insight into her relations cannot be overestimated. The study of biology trains the mind in accurate methods of observation and correct methods of reasoning, and gives to a man clearer points of view, and an attitude of mind serviceable in the working-day-world than that given by other sciences, or even by the humanities.

Aequanimitas, with Other Addresses to Medical Students, Nurses, and Practitioners of Medicine

The Leaven of Science (pp. 91–92)

The Blakiston Company. Philadelphia, Pennsylvania, USA. 1932

Peattie, Donald Culross 1898–1964

American botanist, naturalist, and author

I say that it touches a man that his blood is sea water and his tears are salt, that the seed of his loins is scarcely different from the same cells in a seaweed, and that of stuff life his bones are coral made. I say that a physical and biologic law lies down with him, and wakes when a child stirs in the womb, and that sap in the smell of the loam, where the bacteria bestir themselves in darkness and the path of the sun in the heaven, these are facts of first importance to his mental conclusions, and that a man who goes in no consciousness of them is a drifter and a dreamer, without a home or any contact with reality.

An Almanac for Moderns

April First (p. 14)

G.P. Putnam's Sons. New York, New York, USA. 1935

...grant but a single teleological explanation in biology, and you have left the path of scientific thinking. Plan there may be, but only a working plan, a vast experimentation still in course.

An Almanac for Moderns

May Nineteenth (p. 64)

G.P. Putnam's Sons. New York, New York, USA. 1935

Peter Griffin (Fictional character)

Math. Math my dear boy is nothing more than the lesbian sister of biology.

Family Guy

Film (1999)

Pycraft, W. P.

Nature documentary filmmaker

So long as we insist on regarding biology as a crystallized creed, requiring no more than a possible rectification of some of its tenets, so long shall we continue groping in the dark to get an insight into the mysteries we are professedly trying to solve.

Annual Report of the Board of Regents of the Smithsonian Institution, 1936

Some New Aspects of Evolution (p. 241)

Government Printing Office. Washington, D.C. 1937

Rashevsky, Nicolas 1899–1972

Mathematical biophysicist

There is no successful mathematical theory which would treat the integrated activities of the organism as a whole.... The fundamental manifestation of life drops out from all our theories in mathematical biology.

Mathematical Biophysics: Physico-Mathematical Foundations of Biology (Volume 2)

Chapter XXVIII (p. 306)

The University of Chicago Press. Chicago, Illinois, USA. 1948

Let us, however, appraise the problem [of dealing with forces] realistically. In celestial mechanics, where we deal with forces varying as simply as the inverse square of the distance and acting on rigid masses, the three-body problem, let alone the n-body problem, still defies in its generality the ingenuity of mathematicians. The forces between cells are much more complex; they are non-conservative, and the cells themselves are not merely displaced but also changed externally and internally by these forces. What are the chances within a foreseeable number of generations to even approximately master the problem of an organism as an aggregate of cells, considering that this organism consists of some 10¹⁴ of cells, hundreds of different tissues, and thousands of complex interrelated structures. Pessimism is not a healthy thing in science, but neither is unrealistic optimism.

Mathematical Biophysics: Physico-Mathematical Foundations of Biology (Volume 2)

Chapter XXVIII (p. 307)

The University of Chicago Press. Chicago, Illinois, USA. 1948

When we observe the phenomena of biological integration we notice, however, not quantities, varying continuously or discontinuously, but certain rather complex relations.... Topological analogies go much deeper in the realm of the living when we observe not merely structural but functional (in a biological sense) relations. The unity of the organism and the unity of all life is expressed by just that kind of relation.

Mathematical Biophysics: Physico-Mathematical Foundations of Biology (Volume 2)

Chapter XXVIII (p. 308)

The University of Chicago Press. Chicago, Illinois, USA. 1948

Roberts, Catherine

No biographical data available

The driving force of biology and medical science is not unalloyed idealism but a complex of factors including prestige, publication, professional advancement, grants and business interests.

The Use of Animals in Medical Research – Some Ethical Considerations
Perspectives in Biology and Medicine, Volume VIII, Number 1, Autumn 1964 (p. 116, fn 4)

Root, R. K.

No biographical data available

I can hear my good friend, the Professor of Biology, rather impatiently reporting that his science asks assent only to what it can demonstrate. "Come with me to my laboratory, and I will give you proofs...." But how am I, quite untrained in his science, to weigh his arguments or interpret what his microscopes may show?

The Age of Faith

The Atlantic Monthly, Volume cx, July, 1912 (p. 114)

Rostand, Jean 1894–1977

French historian and biologist

[Biology] is the least self-centered, the least narcissistic of the sciences – the one that, by taking us out of ourselves, leads us to re-establish a link with nature and to shake ourselves free from our spiritual isolation.

Translated by Jonathan Griffin

Can Man Be Modified?

Victories and the Hopes of Biology (p. 31)

Basic Books, Inc. New York, New York, USA. 1959

Sam (Fictional character)

Biology, now there's something you can sink your teeth into, so to speak. Your problem is real. The solution is real.

Ginger Snaps

Film (2000)

Sandeman, George 1863–1952

Spanish-born American philosopher

...the outstanding evil is that every science suffers from an insular ignorance of what is meant by the others; philosophy, for instance, at present knows little of animals and plants but what it has learned through the biology of hypothesis, and accepts the results of the latter for observation; and biology is content to find the true differences of organisms in the structure of small particles within them, through an inadequate knowledge of the methods of physics. In a word, one science is only too ready to accept the abstractions of others as answering to the nature of the matter studied.

Problems of Biology

Chapter I (p. 13)

Swan Sonnenschein & Co., Ltd. London, England. 1896

Sears, Paul Bigelow 1891–1990

American plant ecologist and conservationist

Biology is the link – still too largely a missing link – between the physical and social sciences. Through it, and it alone, can the student come to understand the natural communities of plants and animals which, during the centuries, have shaped his own region for its present human utility.

The Importance of Biology Teaching for Secondary School Pupils

The American Biology Teacher, Volume 1, Number 4, January, 1939 (p. 67)

Shaw, George Bernard 1856–1950

Irish comic dramatist and literary critic

There is nothing like biology. "The cloud-capped towers, the solemn binnacles, the gorgeous temples, the great globe itself: yea, all that it inherit shall dissolve, and, like this influential parent faded, leave not a rack behind." That's biology, you know. Good sound biology.

Back to Methuselah

Part II, XXXIII (p. 48)

Constable & Company Ltd. London, England. 1921

Simpson, George Gaylord 1902–84

American paleontologist

Experimental biology...may reveal what happens to a hundred rats in the course of ten years under fixed and simple conditions, but not what happened to a billion rats in the course of ten million years under the fluctuating conditions of earth history. Obviously, the latter problem is more important.

Tempo and Mode in Evolution

Introduction (p. xvii)

Columbia University Press. New York, New York, USA. 1944

Biology, then, is the science that stands at the centre of all science. It is the science most directly aimed at science's major goal and most definitive of that goal. And it is here, in the field where all the principles of all the sciences are embodied, that science can truly become unified.

This View of Life: The World of an Evolutionist

Chapter Five (p. 107)

Harcourt, Brace & World, Inc. New York, New York, USA. 1964

Standen, Anthony

Anglo-American science writer

Analogy is a wonderful, useful and most important form of thinking, and biology is saturated with it. Nothing is worse than a horrible mass of undigested facts, and facts are indigestible unless there is some rhyme or reason to them. The physicist, with his facts, seeks reason; the biologist seeks something very much like rhyme, and rhyme is a kind of analogy....

Science Is a Sacred Cow

Chapter IV (p. 98)

E.P. Dutton. New York, New York, USA. 1950

In its central content, biology is not accurate thinking, but accurate observation and imaginative thinking, with great sweeping generalizations.

Science Is a Sacred Cow

Chapter IV (pp. 99–100)

E.P. Dutton. New York, New York, USA. 1950

Sullivan, John William Navin 1886–1937

Irish mathematician

It is possible, nevertheless, that our outlook on the physical universe will again undergo a profound change. This change will come about through the development of biology. If biology finds it absolutely necessary, for the description of living things, to develop new concepts of

its own, then the present outlook on “inorganic nature” will also be profoundly affected.... The notions of physics will have to be enriched, and this enrichment will come from biology.

The Limitations of Science

Chapter 7, Section 8 (pp. 188, 189)

New American Library. New York, New York, USA. 1956

Thomson, Sir John Arthur 1861–1933

Scottish naturalist

Biology has a particular end – that of describing the life of plants and animals, and that end is not necessarily achieved by discoveries in the physics and chemistry of living bodies.

Introduction to Science

Chapter II (p. 53)

Henry Holt & Co. New York, New York, USA. 1911

...questions that the biologist must ask and answer before he can go far in generalization appear at first sight to be very numerous and varied, but, from a certain distance, we see that there are only four: What is this living creature as regards form and structure? How does it work? Whence has it arisen? How has it come to be as it is?

Introduction to Science

Classification of the Sciences (p. 110)

Henry Holt & Co. New York, New York, USA. 1911

Tiffany, Lewis

No biographical data available

We believe that there is a unified science of life, a general biology that is distinct from a shotgun marriage of botany and zoology, or any others of the special life sciences. We believe that this science has a body of established and working principles. We believe that literally nothing on earth is more important to a rational living than basic acquaintance with those principles.

Life: An Introduction to Biology (2nd edition)

Preface from First Edition (p. v)

Harcourt, Brace & World, Inc. New York, New York, USA. 1965

Ulam, Stanislaw 1909–84

Polish-born mathematician

After reading about [the biological developments] which were coming fast, I became curious about a conceptual role which mathematical ideas could play in biology. If I may paraphrase one of President Kennedy’s famous statements, I was interested in “not what mathematics can do for biology but what biology can do for mathematics.” I believe that new mathematical schemata, new systems of axioms, certainly new systems of mathematical structures will be suggested by the study of the living world.

Some ideas and prospects in biomathematics

Annual Review of Biophysics and Bioengineering I, 1972 (p. 285)

Weaver, Warren 1894–1978

American mathematician

The century of biology upon which we are now well embarked is no matter of trivialities. It is a movement of really heroic dimensions, one of the great episodes in man’s intellectual history. The scientists who are carrying the movement forward talk in terms of nucleoproteins, of ultra-centrifuges, of biochemical genetics, of electrophoresis, of the electron microscope, or molecular morphology, of radioactive isotopes. But do not be fooled into thinking this is more gadgetry. This is the dependable way to seek a solution of the cancer and polio problems, the problem of rheumatism and of the heart. This is the knowledge on which we must base our solution of the population and food problems. This is the understanding of life.

In R.B. Fosdick

The Story of the Rockefeller Foundation

Letter to H.M.H. Carson, 17 June, 1949 (p. 166)

Harper & Brothers Publishers. New York, New York, USA. 1952

Whitehead, Alfred North 1861–1947

English mathematician and philosopher

Unfortunately in this book of nature the biologists fare badly. Every expression of life takes time. Nothing that is characteristic of life can manifest itself at an instant. Murder is a prerequisite for the absorption of biology into physics as expressed in these traditional concepts.

Supplementary

Aristotelian Society, Volume II, Time, Space and Material (p. 45)

The living cell is to biology what the electron and the proton are to physics.

Science and the Modern World

Chapter VI (p. 146)

The Macmillan Company. New York, New York, USA. 1929

Science is taking on a new aspect that is neither purely physical nor purely biological. It is becoming the study of the larger organisms; whereas physics is the study of the smaller organisms.

Science and the Modern World

Chapter VI (p. 150)

The Macmillan Company. New York, New York, USA. 1929

Accordingly, biology apes the manners of physics. It is orthodox to hold that there is nothing in biology but what is physical mechanism under somewhat complex circumstances.

Science and the Modern World

Chapter VI (p. 150)

The Macmillan Company. New York, New York, USA. 1929

Wilson, Andrew 1852–1912

No biographical data available

There are many less effective things, in the way of modern culture, than a popular training in biology.

Leisure-time Studies, Chiefly Biological: A Series of Essays and Lectures
 Preface
 Chatto & Windus. London, England. 1898

Wilson, Edward O. 1929–
 American biologist and writer

Society increasingly has neglected the substructure of biology to its own peril.
 In Pamela Weintraub (ed.)
The Omni Interviews
 Genetic Destiny (p. 221)
 Ticknor & Fields. New York, New York, USA. 1984

Woodger, Joseph Henry 1894–1981
 English biologist

Biology is being forced in spite of itself to become biological.
 In Herbert J. Muller
Science and Criticism: The Humanistic Tradition in Contemporary Thought
 Chapter V (p. 110)
 G. Braziller. New York, New York, USA. 1943

BIOLOGY, HISTORY OF MARINE

Deacon, G. E. R.
 No biographical data available

An attempt to follow the history of marine biology is like a journey through a labyrinth, the most important signposts of which are obscured by moss.
Seas, Maps, and Men: An Atlas-History of Man's Exploration of the Oceans
 Life in the Sea (p. 77)
 Doubleday. Garden City, New York, USA. 1962

BIONIC ORGANS

Television Introduction

We can make him better than he was. We have the technology.
Bionic Man
 Preamble to the television series

BIOSTRATIGRAPHY

Darwin, Charles Robert 1809–82
 English naturalist

...every year tends to fill up the blanks between the stages, and to make the proportion between the lost and existing forms more gradual. In some of the most recent beds...only one or two species are extinct, and only one or two are new.... Yet if we compare any but the most closely related formations, all the species will be found to have undergone some change.

In *Great Books of the Western World* (Volume 49)
The Origin of Species by Means of Natural Selection
 Chapter XI (p. 167)
 Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Shaw, Alan B.
 No biographical data available

Each objectively definable extinct fossil taxon divides geologic time into three segments – the time before it appeared, the time during which it existed, and the time since its disappearance.
Time in Stratigraphy
 Chapter 17 (p. 102)
 McGraw-Hill Book Company, Inc. New York, New York, USA. 1964

BIRTH CONTROL

Dickens, Charles 1812–70
 English novelist

...accidents will occur in the best-regulated families...
David Copperfield (Volume 1)
 Chapter 28 (p. 454)
 P.F. Collier & Son Company. New York, New York, USA. 1917

Farris, Jean
 No biographical data available

Birth control: Banned parenthood.
Quote, the Weekly Digest, February 18, 1968 (p. 137)

Gäbor, Dennis 1900–79
 Hungarian-English physicist

The technique of birth control can be suppressed only if one abolishes also the technique of death control: medicine and hygiene.
Inventing the Future
 Overpopulation (p. 82)
 Secker & Warburg. London, England. 1963

Sanger, Margaret 1879–1966
 American pioneer birth control advocate

The menace of another pregnancy hung like a sword over the head of every poor woman...
My Fight for Birth Control
 Awaking and Revolt (p. 49)
 Farrar & Rinehart, Incorporated. New York, New York, USA. 1931

“Yes, yes – I know, Doctor,” said the patient with trembling voice, “but,” and she hesitated as if it took all of her courage to say it, “what can I do to prevent getting that way again?”

“Oh, ho! laughed the doctor good naturedly. You want your cake while you eat it too, do you? Well, it can’t be done.... I’ll tell you the only sure thing to do. Tell Jake to sleep on the roof!”
My Fight for Birth Control
 Awaking and Revolt (pp. 52–53)
 Farrar & Rinehart, Inc. New York, New York, USA. 1931

BLACK HOLE

Asimov, Isaac 1920–92
American author and biochemist

Since 1960 the universe has taken on a wholly new face. It has become more exciting, more mysterious, more violent, and more extreme as our knowledge concerning it has suddenly expanded. And the most exciting, most mysterious, most violent, most extreme phenomena of all has the simplest, plainest, calmest, and mildest name – nothing more than a “black hole.”

The Collapsing Universe

Chapter 1 (p. 1)

Walker. New York, New York, USA. 1977

Author undetermined

A black hole is where God divides by zero.
Source undetermined

Cardenal, Ernesto 1925–
Nicaraguan poet and Roman Catholic priest

But a star a little heavier than a neutron star
is a black hole.

The forces of a black hole.

Like a cosmic vacuum cleaner.

Where gravitation is so great, the curvature so great,
that light is swallowed up.

Translated by John Lyons

Cosmic Canticle

Cantigua 3, Autumn Fugue (p. 32)

Curbstone Press. Willimantic, Connecticut, USA. 1993

Chandrasekhar, Subrahmanyan 1910–95
Indian-born American astrophysicist

The black holes of nature are the most perfect macroscopic objects there are in the universe: the only elements in their construction are our concepts of space and time. And since the general theory of relativity provides only a single unique family of solutions for their descriptions, they are the simplest objects as well.

The Mathematical Theory of Black Holes

Prologue (p. 1)

Oxford University Press, Inc. Oxford, England. 1992

Eddington, Sir Arthur Stanley 1882–1944
English astronomer, physicist, and mathematician

I think there should be a law of Nature to prevent a star
from behaving in this absurd way!

Relativistic Degeneracy

Observatory, Volume 58, Number 729, 1935(p. 37)

Gardner, Martin 1914–
American writer and mathematics games editor

Our entire universe may slowly stop expanding, go into a contracting phase, and finally disappear into a black hole, like an acrobatic elephant jumping into its anus.

Science: Good, Bad, and Bogus

Chapter 32 (p. 336)

Prometheus Books. Buffalo, New York, USA. 1981

The healthy side of the black-hole craze is that it reminds us of how little science knows, and how vast is the realm about which science knows nothing.

Science: Good, Bad, and Bogus

Chapter 32 (p. 343)

Prometheus Books. Buffalo, New York, USA. 1981

Hawking, Stephen William 1942–
English theoretical physicist

Although Bekenstein’s hypothesis that black holes have a finite entropy requires for its consistency that black holes should radiate thermally, at first it seems a complete miracle that the detailed quantum-mechanical calculations of particle creation should give rise to emission with a thermal spectrum. The explanation is that the emitted particles tunnel out of the black hole from a region of which an external observer has no knowledge other than its mass, angular momentum and electric charge. This means that all combinations or configurations of emitted particles that have the same energy, angular momentum and electric charge are equally probable. Indeed, it is possible that the black hole could emit a television set or the works of Proust in 10 leather-bound volumes...

The Quantum Mechanics of Black Holes

Scientific American, Volume 236, Number 1, January, 1977 (p. 40)

Israel, Werner 1931–
Canadian physicist

It is one of the little ironies of our times that while the layman was being indoctrinated with the stereotype of black holes as the ultimate cookie monsters, the professionals have been swinging round to the almost directly opposing view that black holes, like growing old, are really not so bad when you consider the alternative.

In John D. Barrow

The World Within the World (p. 312)

Clarendon Press. Oxford, England. 1988

Koestler, Arthur 1905–83
Hungarian-born English writer

Young Archie, the intrepid mole,
Went down to explore a Black Hole.

A stark singularity,

Devoid of all charity,

Devoured the mole as a whole.

In Bernard Dixon (ed.)

From Creation to Chaos: Classic Writings in Science
Cosmic Limerick (p. 108)
Basil Blackwell Ltd. Oxford, England. 1989

Laplace, Pierre Simon 1749–1827
French mathematician, astronomer, and physicist

There exist in the heavens therefore dark bodies, as large as and perhaps as numerous as the stars themselves. Rays from a luminous star having the same density as the Earth and a diameter 250 times that of the Sun would not reach us because of its gravitational attraction; it is therefore possible that the largest luminous bodies in the Universe may be invisible for this reason.

In Jean-Pierre Luminet
Black Holes (p. 6)
Cambridge University Press. New York, New York, USA. 1992

A luminous star, of the same density as the Earth, and whose diameter should be two hundred and fifty times larger than that of the Sun, would not, in consequence of its attraction, allow any of its rays to arrive at us; it is therefore possible that the largest luminous bodies in the universe, may, through this cause, be invisible.

The System of the World (Volume 2)
Book V, Chapter VI (p. 367)
Printed for Richard Phillips
London, England. 1809

Lasota, Jean-Pierre
No biographical data available

Black holes may still be black, but they can no longer hide in disguise. We are learning how to unmask them.

Unmasking Black Holes
Scientific American, Volume 280, Number 5, May, 1999 (p. 47)

Levi, Primo 1919–87
Italian writer and chemist

The sky is strewn with horrible dead suns,
Dense sediments of mangled atoms.
Only desperate heaviness emanates from them,
Not energy, not messages, not particles, not light.
Light itself falls back down, broken by its own weight.

Translated by Ruth Feldman and Brian Swann
Collected Poems
The Black Stars
Faber & Faber Ltd. Boston, Massachusetts, USA. 1988

Longair, Malcolm 1941–
Scottish physicist

“Just keep away from the black hole garbage bin by the door as you leave,” said the Caterpillar. “It’s very useful for getting rid of theoretical papers and weak students!”

Alice and the Space Telescope
Chapter 7 (p. 68)
The Johns Hopkins University Press. Baltimore, Maryland, USA. 1989

Michell, John 1724–93
English geologist and astronomer

If the semi-diameter of a sphere of the same density as the Sun in the proportion of five hundred to one, and by supposing light to be attracted by the same force in proportion to its [mass] with other bodies, all light emitted from such a body would be made to return towards it, by its own proper gravity.

On the Means of discovering the Distance, Magnitude, etc. of the Fixed Stars
Philosophical Transactions of the Royal Society of London, 1784

Milne, A. A. (Alan Alexander) 1882–1956
English playwright, poet, and story writer

A great enormous thing, like – like nothing. A huge big – well, like a – I don’t know – like an enormous big nothing.

The Complete Tales & Poems of Winnie-the-Pooh
Winnie-the-Pooh. Piglet Meets a Heffalump (p. 68)
Dutton Children’s Books. New York, New York, USA. 2001

Ruffini, Remo 1940–
American theoretical physicist

What was once the core of a star no longer visible. The core like a Cheshire cat fades from view. One leaves behind only its grin, the other, only its gravitational attraction. Gravitational attraction, yes; light, no. No more than light do any particles emerge. Moreover, light and particles incident from outside emerge and go down the black hole only to add to its mass and increase its gravitational attraction.

Our Universe: The Known and the Unknown
American Scientist, Volume 56, Number 1, Spring 1968 (p. 9)

Sagan, Carl 1934–96
American astronomer and author

Black holes may be apertures to elsewhere. Were we to plunge down a black hole, we would re-emerge, it is conjectured, in a different part of the universe and in another epoch of time.... Black holes may be the entrances to Wonderland. But are there Alices or white rabbits?

Cosmic Connection: An Extraterrestrial Perspective
Chapter 36 (p. 248)
Anchor Press/Doubleday. Garden City, New York, USA. 1973

Smolin, Lee 1940–
American theoretical physicist

...each black hole is a bud that leads to a new universe of moments.

The Life of the Cosmos
Part Two, Chapter Seven (p. 94)
Oxford University Press, Inc. New York, New York, USA. 1997

Thorne, Kip S. 1940–
American theoretical physicist

Of all the conceptions of the human mind from unicorns to gargoyles to the hydrogen bomb the most fantastic is the black hole: a hole in space with a definite edge over which anything perhaps can fall and nothing can escape;

a hole with a gravitational field so strong that even light is caught and held in its grip; a hole that curves space and warps time.

Cosmology + 1

Chapter 8 (p. 63)

W.H. Freeman & Company, San Francisco, California, USA. 1977

Wheeler, John Archibald 1911–

American theoretical physicist and educator

Every black hole brings an end to time and space and the laws of physics.

Geons, Black Holes, and Quantum Foam: A Life in Physics

Chapter 16 (p. 350)

W.W. Norton & Company, Inc. New York, New York, USA. 1998

BLADDER STONE

Donne, John 1672–1731

English Jacobean poet

Know'st thou but how the stone doth enter in The bladder's cave, and never break the skin?

In E.K. Chambers

Poems of John Donne (Volume 2)

On the Progress of the Soul. Anniversary Two

Charles Scribner's Sons. New York, New York, USA. 1896

BLINDNESS

Keats, John 1795–1821

English Romantic lyric poet

There is a budding morrow in midnight;
There is a triple sight in blindness keen.

The Complete Poetical Works and Letters of John Keats

To Homer

Houghton Mifflin Company. Boston, Massachusetts, USA. 1890

Sophocles 496 BCE–406 BCE

Greek playwright

Oedipus: ...in sound is my sight...

In *Great Books of the Western World* (Volume 5)

The Plays of Sophocles

Oedipus at Colonus, l. 135

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Wordsworth, William 1770–1850

English poet

It is not now as it hath been of yore –
Turn wheresoe'er I may,
By night or day,
The things which I have seen I can now see no more.

The Complete Poetical Works of William Wordsworth

Recollections of Early Childhood

Ode: Intimations of Immortality

Crowell. New York, New York, USA. 1888

BLOOD PRESSURE

Osler, Sir William 1849–1919

Canadian physician and professor of medicine

A man's life may be said to be a gift of his blood pressure, just as Egypt is a gift of the Nile.

In Harvey Cushing

The Life of Sir William Osler (Volume 2) (p. 297)

Clarendon Press. Oxford, England. 1925

BLUEPRINT

Ridley, Matt 1958–

English science writer

Incidentally, you will not find the tired word “blueprint” in this book, after this paragraph, for three reasons. First, only architects and engineers use blueprints and even they are giving them up in the computer age, whereas we all use books. Second, blueprints are very bad analogies for genes. Blueprints are two-dimensional maps, not one-dimensional digital codes. Third, blueprints are too literal for genetics, because each part of a blueprint makes an equivalent part of the machine or building; each sentence of a recipe book does not make a different mouthful of cake.

Genome: The Autobiography of a Species in 23 Chapters

Introduction (p. 8)

HarperCollins Publishers, Inc. New York, New York, USA. 2000

BOOK

Adair, Robert K.

American physicist

It has been said that all expository books are simply forms of selected plagiarism.

The Great Design: Particles, Fields, and Creation

Preface (p. vi)

Oxford University Press. Oxford, England. 1989

Advertisement

If you are young, do not read this book; it is not fit for you; If you are old, throw it away; you have nothing to learn from it; If you are unambitious, light the fire with it; you do not need its guidance.

But, if you are neither less than twenty-five years old, nor more than thirty; And if you are ambitious withal, and your spirit hankers... Read, and may your soul (if you have a soul) find mercy!

Microcosmographia Academica

Bowes & Bowes, Publishers. Cambridge, England. 1908

Agassiz, Jean Louis Rodolphe 1807–73

Swiss-born American naturalist, geologist, and teacher

If you study Nature in books...when you go out of doors you cannot find her.

Quoted in David Starr Jordan

Science Sketches

Agassiz at Penikese (p. 134)

A.C. McClurg & Co. Chicago, Illinois, USA. 1896

Alvarez, Luis Walter 1911–88

American experimental physicist

Ex libro lapidum historia mundi – from the book of rocks comes the history of the Earth.

T. Rex and the Crater of Doom

Chapter 2 (p. 19)

Princeton University Press. Princeton, New Jersey, USA. 1997

Bacon, Sir Francis 1561–1626

English lawyer, statesman, and essayist

But the images of men's wits and knowledges remain in books, exempted from the wrong of time, and capable of perpetual renovation. Neither are they fitly to be called images, because they generate still, and cast their seeds in the minds of others, provoking and causing infinite actions and opinions in succeeding ages ...

The Advancement of Learning (Volume 1)

The First Book (p. 66)

Macmillan & Co Ltd. London, England. 1905

Bernstein, Jeremy 1929–

American physicist, educator, and writer

...a physics book, unlike a novel, not only has no happy ending, but has no real ending at all.

Elementary Particles and Their Currents

Chapter 15 (p. 318)

W.H. Freeman. San Francisco, California, USA. 1968

Boyle, Robert 1627–91

English natural philosopher and theological writer

...if judicious men skilled in chymical affaires shall once agree to write clearly and plainly of them, and thereby keep men from being stunned, as it were, or imposed upon by dark or empty words; 'tis to be hoped that these men finding that they can no longer write impertinently and absurdly, without being laughed at for doing so, will be reduced either to write nothing, or books that may teach us something, and not rob men, as formerly, of invaluable time; and so ceasing to trouble the world with riddles or impertinencies, we shall either by their books receive an advantage, or by their silence escape an inconvenience.

The Sceptical Chymist

The Fourth Part (pp. 116–117)

J.M. Dent & Sons. London, England. 1911

Brewster, George

No biographical data available

A very considerable number of books, which, year after year, emanate from the press, and no small share of the

lectures delivered upon the sciences, are nothing more nor less than the repetition of old ideas in a new garb, to prevent the petty plagiarism from being too barefaced, and that garb too oftentimes made less elegant and less attractive than the original.

A New Philosophy of Matter; Showing the Identity of All the Imponderables (3rd edition)

Chapter I (p. 15)

Edward H. Fletcher. New York, New York, USA. 1858

Brown, Hugh Auchincloss 1878–1975

American electrical engineer

For the earth is a great stone book

With strata of stone for pages;

In which we'll find if we look

The living record of ancient ages.

Cataclysms of the Earth

The Earth Is a Great Stone Book (p. 275)

Twayne Publishers. New York, New York, USA. 1967

Cloos, Hans 1885–1951

German geologist

By far the most important books for geology students were the quarries and clay pits, the cliffs and creek beds, the road and railroad cuts in woods and fields. Our words and letters were the imprints of plants and animals in stone, the minerals and crystals, and our vast inexhaustible, incorruptible, and infallible library was nature itself.

Conversation with the Earth

Chapter II (p. 28)

Alfred A. Knopf. New York, New York, USA. 1953

Comstock, John Henry 1849–1931

American entomologist

Fill your note-book with descriptions, but digest them carefully, sifting out for publication only those that exhaustive study and repeated observations prove to be valuable.

Insect Life: An Introduction to Nature-Study and a Guide for Teachers, Students, and Others

Part II, Chapter III (p. 323)

D. Appleton & Co. New York, New York, USA. 1898

Cornford, Francis M. 1874–1943

English academic

Books are the sources of material for lectures. They should be kept from the young; for to read books and remember what you read well enough to reproduce it is called 'cramming', and this is destructive of all true education. The best way to protect the young from books is, first, to make sure that they shall be so dry as to offer no temptation; and, second, to store them in such a way that no one can find them without several years' training.

Microcosmographia Academica

The Principles of Government, of Discipline (Including Religion), and of Sound Learning

Bowes & Bowes, Publishers. Cambridge, England. 1908

Cushing, Harvey 1869–1939
American neurosurgeon

Books are the most important tools of our craft when assembled in mass in our great medical libraries.

In R. Kagan (ed.)
Leaders of Medicine
Chapter VII (p. 72)
The Medico-Historical Press. Boston, Massachusetts, USA. 1941

Darwin, Charles Robert 1809–82
English naturalist

I have heard, by roundabout channel, that Herschel says my book [*The Origin of the Species*] “is the law of higgledy-piggledy.” What this exactly means I do not know, but it is evidently very contemptuous. If true this is a great blow and discouragement.

In Francis Darwin (ed.)
The Life and Letters of Charles Darwin
Letter to C. Lyell
December 12, 1859 (p. 37)
D. Appleton & Company. New York, New York, USA. 1896

What a book a devil’s chaplain might write on the clumsy, wasteful, blundering, low, and horribly cruel works of nature!

In Sir Francis Darwin (ed.)
More Letters of Charles Darwin (Volume 1)
Letter 48 (p. 95)
D. Appleton & Co. New York, New York, USA. 1903

Darwin, Erasmus 1731–1802
English physician and poet

Now, happier lot! Enlighten’d realms possess
The learned labours of the immortal Press;
Nursed on whose lap the births of science thrive,
And rising Arts the wrecks of Time survive.

The Temple of Nature
Canto IV

Day, Clarence S. 1874–1935
American writer

The world of books is the most remarkable creation of man. Nothing else that he builds ever lasts. Monuments fall; nations perish, civilizations grow old and die out; and after an era of darkness, new races build others. But in the world of books are volumes that have seen this happen again and again, and yet live on, still young, still as fresh as the day they were written, still telling men’s hearts of the hearts of men centuries dead.

The Story of the Yale University Press Told by a Friend (p. 7)
At the Earl Trumbull Williams Memorial. New Haven, Connecticut, USA. 1920

de Bury, Richard 1287–1345
English bibliophile

...all the glory of the world would be buried in oblivion, unless God had provided mortals with the remedy of books.

Translated by E.C. Thomas
The Love of Books Being the Philobiblon of Richard de Bury
Chapter I (p. 9)
Chatto & Windus. London, England. 1925

de Morgan, Augustus 1806–71
English mathematician and logician

The *Theorie des Probabilites* is the Mont Blanc of mathematical analysis; but the mountain has this advantage over the book, that there are guides always ready near the former, whereas the student has been left to his own method of encountering the latter.

Article IV
The Dublin Review, Number IV, April, 1837 (p. 347)

Fabre, Jean-Henri 1823–1915
French entomologist and author

There are for each one of us, according to his turn of mind, certain books that open up horizons hitherto undreamed of and mark an epoch in our mental life. They fling wide the gates of a new world wherein our intellectual powers are henceforth to be employed; they are the spark which lights the fuel on a hearth doomed, without its aid, to remain indefinitely bleak and cold.

Translated by Alexander Teixeira de Mattos
The Hunting Wasps
Chapter I (p. 1)
Dodd, Mead & Co. New York, New York, USA. 1916

Flammarion, Camille 1842–1925
French astronomer and writer

Such a book [a popular treatise on astronomy], altho of more real interest and more attractive than a novel, should be read with attention, and only on this condition can the ideas it contains impart lasting scientific instruction. But whereas when we reach the last page of a novel we know just as much as when we began the first, we must be either blind or oblivious to all intellectual apprehension if the reading of a scientific work does not greatly extend the sphere of our knowledge, and does not more and more elevate the level of our judgment.

Translated by J. Ellard Gore
Popular Astronomy: A General Description of the Heavens
Book I, Chapter I (pp. 1–2)
Chatto & Windus. London, England. 1894

French, John 1616–57
English physician

There is a glut of chemical books, but a scarcity of chemical truths.

Art of Distillation
To the Reader
By E. Cotes for Thomas Williams. London, England. 1653

Goldsmith, Oliver 1728–74
Anglo-Irish writer, poet, and physician

There are an hundred faults in this thing, and an hundred things might be said to prove them beauties. But it is

needless. A book may be amusing with numerous errors, or it may be very dull without a single absurdity.

The Miscellaneous Works of Oliver Goldsmith

The Vicar of Wakefield

Advertisement (p. 1)

Macmillan & Company Ltd. London, England. 1881

Gutenberg, Beno 1889–1960

German-American seismologist

Books and papers dealing with hypotheses on the development of the earth's crust are as the sands of the sea.

Internal Constitution of the Earth

Hypotheses on the Development of the Earth (p. 178)

Dover. New York, New York, USA. 1951

Huxley, Thomas Henry 1825–95

English biologist

Books are the money of Literature, but only the counters of Science.

Collected Essays (Volume 3)

Science and Education

Universities: Actual and Ideal (p. 213)

Macmillan & Company Ltd. London, England. 1904

You may read any quantity of books, and you may be almost as ignorant as you were at starting, if you don't have, at the back of your minds, the change for words in definite images which can only be acquired through the operation of your observing faculties on the phenomena of nature.

Collected Essays (Volume 3)

Science and Education

On the Study of Biology (p. 283)

Macmillan & Company Ltd. London, England. 1904

...a single book tells us more than Methuselah could have learned, had he spent every waking hour of his thousand years in learning ...

Hume

Chapter VII (p. 129)

Macmillan & Company Ltd. London, England. 1902

Johnson, Samuel 1696–1772

English critic, biographer, and essayist

Boswell: But, Sir is it not somewhat singular that you should happen to have Cocker's Arithmetic about you on your journey?

Dr. Johnson: Why, Sir if you are to have but one book with you upon a journey, let it be a book of science. When you read through a book of entertainment, you know it, and it can do no more for you; but a book of science is inexhaustible.

In James Boswell

The Life of Samuel Johnson, LL.D. Part Two

Chapter XIV (p. 268)

P.F. Collier & Son. New York, New York, USA. 1901

Sir, to leave things out of a book merely because people tell you they will not be believed, is meanness.

In James Boswell

The Life of Samuel Johnson, LL. D.

1772–AETAT. 63 (p. 281)

George Dearborn. New York, New York, USA. 1833

Kant, Immanuel 1724–1804

German philosopher

I did not enter on the prosecution of this undertaking [writing the book] until I saw myself in security regarding the duties of religion. My zeal was redoubled when at every step I saw the clouds disperse that appeared to conceal monsters behind their darkness; and when they were scattered I saw the glory of the Supreme Being break forth with the brightest splendor.

Translated by W. Hastie

Kant's Cosmogony

Preface (p. 18)

James Maclehose & Sons. Glasgow, Scotland. 1900

King, Charles William 1818–88

English writer

I have therefore once again gone with a will into the mines of antiquity to dig out fresh ore – no fear of exhausting the endless veins; have again wandered lovingly through the true Aladdin's Garden of Eastern literature, plucking its fruits, which be all manner of precious stones – no fear of thinning the teeming crop; or, to descend to prose, have carefully referred to my copious stock of notes and collectanea, and selected much therefrom that struck me as calculated to increase the interest and the utility of numerous portions of the work before me.

The Natural History, Ancient and Modern, of Precious Stones and Gems, and of the Precious Metals

Preface (p. vi)

Bell & Daldy. London, England. 1867

Lemery, Nicolas 1645–1715

French chemist

My Lord, the Treatise I now offer you, is not writ after the usual way of ordinary Chymists, it has none of the bombastik Expressions nor ridiculous Pretences, none of the Melancholick dreams and wretched Enthusiasms, none of the palpable Falsities, and even Impossibilites, wherewith the common rate of Chymical Books has been stuff'd hitherto.

Course of Chemistry (English edition)

Dedication

London. 1677

Locke, John 1632–1704

English philosopher and political theorist

Things in print must stand and fall by their own worth, or the reader's fancy.

An Essay Concerning Human Understanding

Dedication (p. iii)

Printed for Thomas Tegg. London, England. 1841

I here put into thy hands, what has been the diversion of some of my idle and heavy hours: if it has the good luck to prove so of any of thine, and thou hast but half so much pleasure in reading, as I had in writing it, thou wilt as little think thy money, as I do my pains, ill bestowed.

An Essay Concerning Human Understanding

Epistle to the Reader (p. v)

Printed for Thomas Tegg. London, England. 1841

Maxwell, James Clerk 1831–79

Scottish physicist

...the perusal of it [Isaac Taylor's *Physical Theory of Another Life*] has a tendency rather to excite speculation than to satisfy curiosity, and the author obtains the approbation of the reader, while he fails to convince him of the soundness of his views ...

In Lewis Campbell and William Garnett

The Life of James Clerk Maxwell

Appendix A (p. 341)

Macmillan & Co Ltd. London, England. 1884

Mills, Simeon

No biographical data available

To learn from books, stores the mind with the wisdom of the past, but teaches us nothing that was not known before the books were made.

Readings from the Book of Nature

Chapter I (p. 11)

Charles H. Kerr & Co. Chicago, Illinois, USA. 1893

Newman, James Roy 1911–66

Mathematician and mathematical historian

The style of the book certainly suggests teamwork. It is by turns waggish, pompous, chummy, coy, brutal, arch, rude, man-to-man, Air Force crisp, energetic, tongue-tied, pretentious, ingenuous, spastic, ironical, savage, malapropos, square-bashing and moralistic. Solecisms, pleonasms and jargon abound; The clichés and fused participles are spectacular; there are many sad examples of...cannibalism – words devouring their own kind.

Book review of *Thermonuclear War*

Scientific American, Volume 204, Number 2, March, 1961 (p. 197)

Mitchell, Maria 1818–89

American astronomer and educator

Newton rolled up the cover of a book; he put a small glass at one end, and a large brain at the other – it was enough.

In Phebe Mitchell Kendall

Maria Mitchell: Life, Letters, and Journals

Chapter IX (p. 180)

Lee & Shepard. Boston, Massachusetts, USA. 1896

Osler, Sir William 1849–1919

Canadian physician and professor of medicine

I am firmly convinced that the best book in medicine is the book of Nature, as written large in the bodies of men.

The Natural Method of Teaching the Subject of Medicine

Journal of the American Medical Association, Volume 36, 1901

Pascal, Blaise 1623–62

French mathematician and physicist

The last thing one settles in writing a book is what one should put in first.

In *Great Books of the Western World* (Volume 33)

Pensées

Section I, 19

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Ramón y Cajal, Santiago 1852–1934

Spanish neuropathologist

We may learn a great deal from books, but we learn much more from the contemplation of nature – the reason and occasion for all books.

Advice for a Young Investigator

Chapter 4 (p. 62)

The MIT Press. Cambridge, Massachusetts, USA. 1999

Richardson, David Lester 1801–65

Poet and writer

It is an exquisite encouragement to the toiling heart of genius to remember that books are immortal!

Literary Chit-Chat

Chapter X (p. 85)

P.S. D'Rozario and Co. Calcutta, India. 1848

Rota, Gian-Carlo 1932–

Italian-born American mathematician

When too many books are written on a subject, one of two suspicions arises: either the subject is understood and the book is easy to write – as is the case with books on real variables, convexity, projective geometry in the plane, or compact orientable surfaces. Or the subject is important, but nobody understands what is going on; such is the case with quantum field theory, the distribution of primes, pattern recognition, and cluster analysis.

Indiscrete Thoughts

Chapter XX (p. 216)

Birkhäuser. Boston, Massachusetts, USA. 1997

Sagan, Carl 1934–96

American astronomer and author

Books permit us to voyage through time, to tap the wisdom of our ancestors. The library connects us with the

insights and knowledge, painfully extracted from Nature, of the greatest minds that ever were, with the best teachers, drawn from the entire planet and from all of our history, to instruct us without tiring, and to inspire us to make our own contribution to the collective knowledge of the human species.

Cosmos

Chapter XI (p. 233)

Ballentine Books. New York, New York, USA. 1985

Schuster, Arthur 1851–1934

German-born English physicist

If we ransack old books of science we often come across passages of long-forgotten writings, in which, when they are properly construed, when new meanings are given to old words and obscure expressions are freely translated, we may trace a faint prophetic glimmering of a modern theory.

The Influence of Mathematics on the Progress of Physics

van Nostrand's Engineering Magazine, Volume XXVI, Number CLX, April, 1882 (p. 317)

Slosson, Edwin E. 1865–1929

American chemist and journalist

The Book of Nature is issued only in uncut editions, and the scientist has to open its pages one by one as he reads.

Keeping Up with Science

Introduction (p. vi)

Jonathan Cape. London, England. 1924

One obstacle in the way of spreading science, that is, of inculcating the scientific habit of mind, is that people have learned to read too well. Books may become an impediment to learning. Our students are taught how to learn to read but not always how to read to learn.

Digest of the Proceedings of the Second Annual Meeting of the American Association for Adult Education

Adult Education in Science, 1927 (p. 53)

Thomson, Sir John Arthur 1861–1933

Scottish naturalist

What then is the aim of this book? It is to give the intelligent student-citizen, otherwise called “the man in the street,” a bunch of intellectual keys by which to open doors which have been hitherto shut to him, partly because he got no glimpse of the treasures behind the doors, and partly because the portals were made forbidding by an unnecessary display of technicalities.

The Outline of Science: A Plain Story Simply Told

Introductory Notes (p. iii)

G.P. Putnam's Sons. New York, New York, USA. 1922

Thompson, Silvanus P. 1851–1916

English physics professor and author

One other thing will the professed mathematicians say about this thoroughly bad and vicious book: that the

reason why it is so easy is because the author has left out all the things that are really difficult. And the ghastly fact about this accusation is that – it is true!

Calculus Made Easy: Being a Very-Simplest Introduction to Those Beautiful Methods of Reckoning Which Are Generally Called by the Terrifying Names of the Differential Calculus and the Integral Calculus (2nd edition)

Epilogue and Apologue (p. 284)

The Macmillan Company. New York, New York, USA. 1929

Thoreau, Henry David 1817–62

American essayist, poet, and practical philosopher

Our books of science, as they improve in accuracy, are in danger of losing the freshness and vigor and readiness to appreciate the real laws of Nature, which is a marked merit in the oftentimes false theories of the ancients.

The Writings of Henry David Thoreau (Volume 1)

A Week on the Concord and Merrimack Rivers

Friday (pp. 479–480)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1893

I would keep some book of natural history always by me as a sort of elixir, the reading of which should restore the tone of the system. To the sick, indeed, nature is sick, but to the well, a fountain of health.

The Writings of Henry David Thoreau (Volume 5)

Natural History of Massachusetts (p. 105)

Houghton Mifflin & Co. New York, New York, USA. 1906

One studies books of science merely to learn the language of naturalists, to be able to communicate with them.

In Harrison Gray Otis Blake (ed.)

The Writings of Henry David Thoreau

March 23, 1853 (p. 212)

Houghton Mifflin Co. Boston, Massachusetts, USA. 1893

Tyndall, John 1820–93

Irish-born English physicist

It is one of the disadvantages of reading books about natural scenery that they fill the mind with pictures, often exaggerated, often distorted, often blurred, and, even when well drawn, injurious to the freshness of first impressions.

Fragments of Science: A Series of Detached Essays, Addresses, and Reviews

Chapter VII (p. 175)

D. Appleton & Co. New York, New York, USA. 1897

Half of our book writers describe experiments which they never made, and their descriptions often lack both force and truth; but, no matter how clever or conscientious they may be, their written words cannot supply the place of actual observation.

Fragments of Science

Part One

A Lecture to School Masters (p. 365)

P.F. Collier & Son. New York, New York, USA. 1901

Valéry, Paul 1871–1945

French poet and critic

Nearly all the books I prize, and absolutely all that have been of any use to me, are books that don't make easy reading.

Translated by Stuart Gilbert

The Collected Works of Paul Valéry (Volume 14)

Analects

Odds and Ends (p. 17)

Princeton University Press. Princeton, New Jersey, USA. 1979

Willmott, Robert Eldridge Aris 1809–63

English writer, poet

Every noble book is a stronghold of the mind, built upon some high place of contemplation, and overlooking wide tracts of intellectual country.

Pleasures, Objects, and Advantages, of Literature (4th edition)

Chapter X (p. 37)

G. Routledge & Co. London, England. 1855

Whether a book be read from the oak lectern of a college library, in the parlor window, or beneath the trees of summer, no fruit will be gathered unless the thoughts are steadily given up to the perusal.

Pleasures, Objects, and Advantages, of Literature (4th edition)

Chapter X (p. 37)

G. Routledge & Co. London, England. 1855

Wittgenstein, Ludwig Josef Johann 1889–1951

Austrian-born English philosopher

The popular scientific books by our scientists aren't the outcome of hard work, but are written when they are resting on their laurels.

Translated by Peter Winch

Culture and Value (p. 42e)

The University of Chicago Press. Chicago, Illinois, USA. 1980

BOOK REVIEW

Chapman, C. H.

No biographical data available

In a review article it is impossible to do more than point out with hasty gestures the landmarks which must guide the traveler who would explore the vast intellectual territory ...

Book Review of *The Theory of Transformation Groups*

Bulletin of the New York Mathematical Society, Volume 2, Number 4, January, 1893 (p. 69)

Marquis, Don 1878–1937

American newspaperman, poet, and playwright

boss a new book

has appeared

which should be read by every one

it is entitled

the cockroach

its life history

and how to deal with it and

the author

is frederick laing

who is assistant

in the department

of entomology in the

british museum

of natural history

it is one of the

best books i ever

tasted i am eating

the binding from

a copy with

a great deal of

relish and recommend it

to all other

insects

the lives and time of archy & mehitabel

book review (p. 253)

Doubleday Doran & Co. Garden City, New York, USA. 1934

BOSON

Gilmore, Robert

No biographical data available

Bosons *like* to get together in the same state. Bosons are easily led; they are inherently gregarious.

Alice in Quantum Land

Chapter 5 (p. 85)

Springer-Verlag. New York, New York, USA. 1955

BOTANICAL

Goebel, Karl 1855–1932

German botanist

If we may use a metaphor, we might say that Botanical Science is like a mountaineer, who, after long, weary climbing, only discovers that after all there still rises – steep and apparently impossible to scale – the real peak; but, notwithstanding this, on casting his eyes around, he finds himself well rewarded for the toil he has undergone.

On the Study of Adaptations in Plants

Science Progress, 1894

BOTANIST

Allen, Grant 1848–99

Canadian-born writer

...if you ever venture to say again behind my back that the botanist is a dull, dried-up, unimaginative person, who cares nothing for the beauty of the lovely flowers, but goes in only for classification, herbariums, and sesquipedalian Latin names, I will arise and slay you with

my hand in another article just as long and every bit as argumentative as this one.

The Joy of Living

Murray's Magazine, Volume I, Number 3, April, 1877 (p. 405)

Author undetermined

We botanists cannot be so mathematically exact as geographers, and where an isthmus is very narrow, [the geographers] must class the peninsula with the island. How often does it happen that two large orders, say of five hundred to two thousand or three thousand species, totally distinct from each other in all these species by a series of constant characters, are yet connected by some small isolated genus of a dozen, half a dozen, nay a single species in which these characters are so inconstant, uncertain or variously combined as to leave no room for the strait, through which we ought to navigate between the two islands.

De Candolle's *Prodromus*

London Journal of Botany, Volume IX, 1845 (p. 232)

My mother is a botanist, and she even names a flower after me. It's called the Bloomin' Idiot.

Source undetermined

...a botanist is too commonly looked upon as merely one who can call plants by name. Making specimens and naming plants no more make a botanist than taking an altitude makes an astronomer.

Sketch of Professor Gray

The Popular Science Monthly, August, 1872 (p. 491)

Barton, Benjamin Smith 1766–1815

American scientist

No man [can] become a nice, discriminating, and eminent botanist, without possessing that acumen in perception in proportion, colour, harmony of design, and obscure differences in the objects of the vegetable world, which alone belong to the eye of the painter.

In William Paul Crillon Barton,

A Biographical Sketch Read Pursuant to Appointment before the Philadelphia Medical Society (p. 7)

The Philadelphia Medical Society. Philadelphia, Pennsylvania, USA. 1816

Brandes, Georg Morris Cohen 1842–1927

Danish literary critic

It makes the plant neither more nor less interesting that it smells sweet or stings; but the dispassionate interest of the botanist is often accompanied by the purely human pleasure in the beauty of the flower.

Main Currents in Nineteenth Century Literature

Introduction (p. 3)

The Macmillan Co. New York, New York, USA. 1906

Butler, Samuel 1612–80

English novelist, essayist, and critic

Why should the botanist, geologist or other-ist give himself such airs.... Is it because he names his plants or specimens with Latin names, and divides them into genre and species...

In Geoffrey Keynes and Brian Hill (eds.)

Samuel Butler's Notebooks

Botanists and Draper's Shopman (p. 264)

Jonathan Cape. London, England. 1951

A botanist is a person whose aim is to uproot, kill and exterminate every plant that is at all remarkable for rarity or any special virtue, and the rarer it is the more bitterly he will hunt it down.

The Note-books of Samuel Butler

Chapter XVII (p. 281)

E.P. Dutton & Co. New York, New York, USA. 1917

Croll, Oswald 1560–1609

German chemist and physician

Oh that the Botanists of our time, who being ignorant of the internal Form of plants, know only their matter, substance, and body, would devote as much care to the discernment of the Signatures of Plants as they do to their manifold and frequently frivolous disputes about the accurate naming of them, it would render a much richer and more beneficial service to medicine.

Basilica Chymica

Tractatus de Signaturis (p. 1)

Printed for John Starkey. London, England. 1670

Crothers, Samuel McChord 1857–1927

American clergyman and writer

Here are botanists who love the growing things in the fields and woods better than the specimens in their herbariums. They love to describe better than to analyze. Now and then one may meet a renegade who carries a geologist's hammer. It is a sheer hypocrisy, like a fishing rod in the hands of a contemplative Rambler. It is merely an excuse for being out of doors and among the mountains.

The Gentle Reader

The Hinter-Land of Science (pp. 236–237)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1903

Darwin, Charles Robert 1809–82

English naturalist

But there is a growing pleasure in comparing the character of the scenery in different countries, which to a certain degree is distinct from merely admiring its beauty. It depends chiefly on an acquaintance with the individual parts of each view. I am strongly induced to believe that as in music, the person who understands every note will, if he also possesses a proper taste, more thoroughly enjoy

the whole, so he who examines each part of a fine view, may also thoroughly comprehend the full and combined effect. Hence, a traveler should be a botanist, for in all views plants form the chief embellishment.

The Voyage of the Beagle

Chapter XXI (pp. 502–503)

Heron Books. Sheridan, Oregon, USA. 1968

Farley, Harriet 1817–1907

American writer and editor

The Botanist looks with a more earnest eye upon the beauties of Nature, than does the Painter or the Poet; and in those plants which escape the notice of the latter, he can find both occupation and amusement.

Shells from the Strand of the Sea of Genius

The Pleasure of Science (p. 12)

J. Munroe and Co. Boston, Massachusetts, USA. 1847

Fisher, Robert

No biographical data available

To be a Botanist is to be like a traveler, going from country to country, and in each finding new wonders and new beauties.

Flower-Land: An Introduction to Botany (p. 3)

Bemrose & Sons. London, England. 1889

Holder, Charles Frederick 1851–1915

American sportsmen and naturalist

The field botanist is one who, being passionately fond of plants, and having mastered the rudiments of botany and become familiar with the names and classification of plants, searches the country for new and rare species, and for new localities for old ones ...

Charles Darwin, His Life and Work

Chapter XX (p. 243)

G.P. Putnam's Sons. New York, New York, USA. 1899

Hunter, Maddy

Writer

You know how most women go into a clothing store and have to finger all the soft fabrics and fur collars? Botanists are like that, too, except instead of touching merchandise, we're all over the local flora. We can't keep our hands off those unfamiliar leaves and flowers, and unfortunately, nature tends to be thorny.

G'day to Die: A Passport to Peril Mystery (p. 102)

Pocket Books. New York, New York, USA. 2006

Johnson, Samuel 1696–1772

English critic, biographer, and essayist

"Are you a botanist, Dr. Johnson?"

"No, Sir, (answered Johnson,) I am not a botanist; and, (alluding no doubt, to his near sightedness) should I wish to become a botanist, I must first turn myself into a reptile."

Boswell's "Life of Samuel Johnson"

Summer 1762 (p. 267)

Oxford University Press, Inc. Oxford, England. 1965

Kett, Henry 1761–1825

English college teacher and writer

The botanist follows nature into her most retired abodes, and views her in her simple taste, and native majesty.

Elements of General Knowledge (Volume 2)

Chapter IV (p. 125)

Printed by E. Bronson. Philadelphia, Pennsylvania, USA. 1805

The botanist enjoys a pleasing and innocent amusement, most agreeably combined with a love of rural retirement, and which gives a new and growing interest to every walk and ride, in the most delightful season of the year. He collects a harvest from all countries for the purpose of reviewing his treasures at leisure, and growing rich in scientific acquirements.

Elements of General Knowledge (Volume 2)

Chapter IV (p. 126)

Printed by E. Bronson. Philadelphia, Pennsylvania, USA. 1805

Kington, Miles 1941–

English journalist, jazz musician and broadcaster

The way botanists divide up flowers reminds me of the way Africa was divided into countries by politicians.

Nature Made Ridiculously Simple, or, How to Identify Absolutely Everything

Linnaeus, Carl (von Linné) 1707–78

Swedish botanist and explorer

To you, my dearly-beloved botanists, I submit my rules, the rules which I have laid down for myself, and in accordance with which I intend to walk. If they seem to you worthy, let them be used by you also; if not, please propound something better!

Critica Botanica

Preface (pp. xxiii–xxiv)

The Ray Society. London, England. 1938

Masters, M. T.

No biographical data available

On the principle of recognising Hercules from his foot, or a lion by his claw, a botanist is too often expected to recognise some miserable scrap of a specimen, smashed it may be beyond hope of certain recognition in its transit through the post, and rendered unrecognisable by the stupid practice of enveloping the "specimen" in cotton wool.

On the Nomenclature of Garden Plants

Journal of the Royal Horticultural Society, Volume V 1879 (p. 127)

Moore, Jared Sparks 1879–1951

American psychologist

The dissecting botanist is interested in the ugliest weed as much as in the beautiful flower ...

The Foundations of Psychology

Book II, Chapter IV (p. 100)

Princeton University Press. Princeton, New Jersey, USA. 1921

Rousseau, Jean-Jacques 1712–78

Swiss-French philosopher

...I know no rational study which is only a science of words: and to which of the two, I pray you, shall I grant the name of botanist, – to him who knows how to spit out a name or a phrase at the sight of a plant, without knowing anything of its structure, or to him who, knowing that structure very well, is ignorant nevertheless of the very arbitrary name that one gives to the plant in such and such a country?

Quoted in John Ruskin

Proserpina: Studies of Wayside Flowers (Volume 2)

Book IX, Chapter VI (pp. 127–128)

George Allen. London, England. 1882

Ruskin, John 1819–1900

English writer, art critic, and social reformer

...the recent phrenzy for the investigation of digestive and reproductive operations in plants may by this time have furnished the microscopic malice of botanists with providentially disgusting reasons, or demoniacally nasty necessities, for every possible spur, spike, jag, sting, rent, blotch, flaw, freckle, filth, or venom, which can be detected in the construction, or distilled from the dissolution, of vegetable organism.

Proserpina: Studies of Wayside Flowers (Volume 2)

Part VII, Chapter I (p. 6)

George Allen. London, England. 1882

Sayre, G. Armington

No biographical data available

A fundamental principle in the higher education of botanists is embodied in the simple lines – “To love the flower and leave it on its stalk.” To do this requires more heroism than the majority of collectors possess.

Devastation of Nature

The American Botanist, Volume I, Number 1, July 1901 (p. 2)

Teale, Edwin Way 1899–1980

American naturalist

Today I had lunch in the city with two scientists, a botanist and an ichthyologist. The botanist said he never kept a garden and the ichthyologist said he never went fishing.

Circle of the Seasons

December 8 (p. 282)

Dodd, Mead & Company. New York, New York, USA. 1953

Timiriazeff, C. A.

Russian botanist

It is not, I think, much beside the mark to say that the word ‘botanist’ still calls up in the minds of many even well educated people not conversant with science one of two

pictures. Either they expect in the botanist a tedious pedant with an inexhaustible vocabulary of double-barrelled Latin names, sometimes most barbarous, who is able to name at a glance any kind of plant, and also ready on occasion, it may be, to describe (quite incorrectly) their medicinal properties – the type of botanist who bores one to death and is certainly incapable of exciting any interest in his subject: or, on the other hand, ‘botanist’ depicts the somewhat less sombre figure of the passionate lover of flowers, who flits like a butterfly from one bloom to another, admiring their bright colouring, inhaling their perfume, singing the praises of the proud rose and the modest violet – in other words, the elegant adept of the *amabilis scientia*, as botany was called in olden times.

Translated by Anna Sheremeteva

Die Sinne der Pflanzen

Chapter I (p. 1)

Longmans, Green & Co. London, England. 1912

A botanist is either a pedantic nomenclator or an amateur horticulturist, an apothecary or an aesthete; but in no sense is he a man of science.

Translated by Anna Sheremeteva

Die Sinne der Pflanzen

Chapter I (p. 1)

Longmans, Green & Co. London, England. 1912

Tolstoy, Leo 1828–1910

Russian writer

...the botanist who finds that the apple falls because the cellular tissue decays and so forth is equally right with the child who stands under the tree and says the apple fell because he wanted to eat it and prayed for it.

Translated by Leo Wiener

War and Peace

Book 9, Chapter I (p. 8)

J.M. Dent & Co. London, England. 1904

BOTANY

Abbot, Charles 1761–1817

Grammar school teacher

The fair daughters of Albion have evinced a zeal and ardor in Botanical researches which have not only done the highest honor to themselves, but have eminently contributed to rescue these pursuits from unmerited reproach, to elevate them into reputation, and to impart to them, if not a superior value, at least a superior currency and fashion. – That such excellence should have been attained in this branch of science by so many of the female sex, notwithstanding the disadvantages they labour under from the want of scholastic and technical instruction, is a convincing proof of the liberality with which Nature has endowed the female mind.

Flora Bedfordiensis

Printed by W. Smith. London, England. 1798

Author undetermined

I hate botany. What is the good of having a set of rules which divide flowers off into classes, and teach one how to analyse them? I shouldn't care for a flower a bit better for knowing how it is constructed. Only fancy, on the very first page, the book told me to cut up an anemone. I couldn't do it – it went to my heart; so I cut up the book instead and threw it into the kitchen-fire.

Reata: Or, What's in a Name (part III)

Blackwood's Edinburgh Magazine, Volume 25, Number 763, May, 1879 (p. 529)

Bierce, Ambrose 1842–1914

American newspaperman, wit, and satirist

BOTANY, n. The science of vegetables – those that are not good to eat, as well as those that are. It deals largely with their flowers, which are commonly badly designed, inartistic in color, and ill-smelling.

The Cynic's Word Book

Botany (p. 37)

Doubleday, Page & Co. New York, New York, USA. 1906

Burroughs, John 1837–1921

American naturalist and writer

We study botany so hard that we miss the charm of the flower entirely.

In the Noon of Science

The Atlantic Monthly, Volume cx, September, 1912 (p. 324)

Cable, George W. 1844–1925

American writer and reformer

She loved no other part of botany quite so much as its Latin.

Strong Hearts

The Entomologist

Chapter II (p. 97)

MSS Information Corporation. New York, New York, USA. 1970

Coffin, Henry Sloane 1877–1954

American Presbyterian clergyman

Botany differs from century to century as men learn more; but the plants and trees remain the same.

University Sermons

The Fallacy of Origins (p. 207)

Yale University Press. New Haven, Connecticut, USA. 1914

Corner, E. H. J.

No biographical data available

Botany needs help from the tropics. Its big plants will engender big thinking.

In Margaret D. Lowman

Life in the Treetops: Adventures of a Woman in Field Biology

Introduction (p. 1)

Yale University Press. New Haven, Connecticut, USA. 1999

Dickens, Charles 1812–70

English novelist

B-o-t, bot, t-i-n, tin, bottin, n-e-y, ney, bottinney, noun substantive, a knowledge of plants. When he has learned that bottinney means a knowledge of plants, he goes and knows 'em. That's our system, Nickleby: what do you think of it?

The Life and Adventures of Nicholas Nickleby (Volume 1)

Chapter VIII (p. 95)

James R. Osgood & Co. Boston, Massachusetts, USA. 1875

Dickinson, Emily 1830–86

American lyric poet

I pull a flower from the woods, –
A monster with a glass
Computes the Stamens in a breath,
And has her in a class.

The Complete Poems of Emily Dickinson

No. 70 (p. 36)

Little, Brown & Company. Boston, Massachusetts, USA. 1960

It is foolish to call them “flowers” –
Need the wiser tell?
If the Savants “Classify” them,
It is just as well!

The Complete Poems of Emily Dickinson

No. 168 (p. 79)

Little, Brown & Company. Boston, Massachusetts, USA. 1960

Einstein, Albert 1879–1955

German-born physicist

One ought to be ashamed to make use of the wonders of science embodied in a radio set, the while appreciating them as little as a cow appreciates the botanic marvels in the plants she munches.

Cosmic Religion, with Other Opinions and Aphorisms

On Radio (p. 93)

Covici-Fiede. New York, New York, USA. 1931

Emerson, Ralph Waldo 1803–82

American lecturer, poet, and essayist

To science there is no poison; to botany no weed; to chemistry no dirt.

The Complete Works of Ralph Waldo Emerson (Volume 12)

Natural History of Intellect

Chapter I (p. 55)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1904

But these young scholars, who invade our hills,
Bold as the engineer who fells the wood,
And travelling often in the cut he makes,
Love not the flower they pluck, and know it not
And all their botany is Latin names.
The old men studied magic in the flowers.

The Complete Works of Ralph Waldo Emerson (Volume 9)

Blight (p. 140)

Houghton Mifflin Company. Boston, Massachusetts, USA. 1904

Our botany is all names, not powers: poets and romancers talk of herbs of grace and healing, but what does the botanist know of the virtues of his weeds?

The Conduct of Life

Beauty (p. 281)

Houghton Mifflin Co. Boston, Massachusetts, USA. 1904

Gerard, John 1545–1612

English herbalist

Although my paines have not been spent (curteous Reader) in the gratuitous discoveries of golden mines, nor in the tracing after silver veins, whereby my native country might be enriched with such merchandize as it hath most in request and admiration; yet hath my labor (I trust) been otherwise profitably employed, in descrying of such a harmless treasure of herbes, trees, and plants, as the earth frankly without violence offereth unto our most necessarie uses.

The Herbal of John Gerard

Preface

Publisher undetermined

Gilmour, John 1906–86

English plant taxonomist and horticulturist

Botany is perhaps the least sensational of sciences. The importance of the vegetable kingdom in human affairs is basic rather than immediate, and only rarely – as in the case of penicillin – does plant science enjoy the bold type of a headline.

British Botanists

Introductory (p. 7)

Collins. London, England. 1946

Gray, Asa 1810–88

American botanist

Great as the merits of the work undoubtedly are, we must nevertheless be excused from adopting the terms of extravagant and sometimes equivocal eulogy employed by a popular author, who gravely informs his readers that no book, since printed Bibles were first sold in Paris by Dr. Faustus, ever excited so much surprise and wonder as did Dr. Torrey's edition of Lindley's *Introduction to the Natural System of Botany*.

In Charles Sprague Sargent

Scientific Papers of Asa Gray (Volume 1)

Lindley's *Natural System of Botany* (pp. 1–2)

Houghton Mifflin & Co. Boston, Massachusetts, USA. 1869

Hale, Sarah Josepha Buell 1788–1879

American writer

The explanations of these [classes and orders] must necessarily be very brief; my aim being rather to stimulate curiosity respecting the subject of Botany than to impart instruction is the science.

The Book of Flowers

Introduction (p. vii)

Saunders & Otley. London, England. 1836

Henry, Thomas

No biographical data available

The sciences of Natural History and Botany require so much time to be devoted to them that, however pleasing, they may be justly considered as improper objects for the man of business to pursue scientifically, so as to enter into the exact arrangement and classification of the different bodies of the animal, vegetable, and mineral kingdoms. But reading and personal observation will supply him with ample matter for reflection and admiration.

Memoirs and Proceedings – Manchester Literary and Philosophical Society

On the Advantages of Literature and Philosophy in General and Especially on the Consistency of (p. 79)

Literary and Philosophical with Commercial Pursuits

Taylor & Francis. London, England. 1883

Henslow, John Stevens 1796–1861

English botanist

To obtain a knowledge of a science of observation, like botany, we need make very little more exertion at first than is required for adapting a chosen set of terms to certain appearances of which the eye takes cognizance, and when this has been attained, all the rest is very much like reading a book after we have learned to spell, where every page affords a fresh field of intellectual enjoyment.

On the Requisites Necessary for the Advance of Botany

Magazine of Zoology and Botany, Volume 1, 1837 (p. 115)

Herbert, Edward 1856–1925

Old Testament scholar

Lee, Sidney L.

No biographical data available

I conceive it is a fine study, and worthy a gentleman to be a good botanic, that so he may know the nature of all herbs and plants, being our fellow-creatures, and made for use of man.

The Autobiography of Edward (p. 57)

John C. Nimo. London, England. 1886

Howitt, William 1792–1879

English author

Botany has introduced us to a more intimate acquaintance with the names and characters, and with something also of the physical economy of both “the trees of the wood” and of the smallest plants which flourish at their feet; so that wherever we cast our eyes, we behold matter for both admiration and research.

The Book of the Seasons

October (pp. 353–354)

Henry Colburn & Richard Bentley. London, England. 1831

Jefferson, Thomas 1743–1826

3rd president of the USA

And botany I rank with the most valuable sciences, whether we consider its subjects as furnishing the principal subsistence of life to man and beast, delicious

varieties for our tables, refreshment from our orchards, the adornments of our flower-borders, shade and perfume of our groves, materials for our buildings or medicaments for our bodies ...

In Eva Beard

Thomas Jefferson, Statesman and Scientist

Nature Magazine, April, 1958 (p. 202)

Kelvin, Lord William Thomson 1824–1907

Scottish engineer, mathematician, and physicist

Forty years ago I asked Liebig walking somewhere in the country, if he believed that the grass and flowers which we saw around us grew by mere chemical forces; he answered, “NO, no more than I could believe that a book of botany describing them grew by mere chemical force.”

In P. Thompson

The Life of William Thomson (Volume 2)

Letter to *The Times*, May 2, 1903 (pp. 1099–1100)

Lincoln, Almira H. 1793–1884

Botanist

A person ignorant of Botany, on beholding the profusion of flowers which adorn the face of nature, would discover general resemblances, and form in his mind some order of arrangement; but the Botanist learns to distinguish the least conspicuous parts of a plant as most important in a system of classification.

Familiar Lectures on Botany, Practical, Elementary and Physiological Introduction (p. 10)

F.J. Huntington & Co. New York, New York, USA. 1853

Linnaeus, Carl (von Linné) 1707–78

Swedish botanist and explorer

What toils, what science would be more wearisome and painful than Botany, did not some singular spell of desire, which I myself cannot define, often hurry us into this pursuit, so that the love of plants often overcomes our self-love? Good God! When I observe the fate of Botanists, upon my word I doubt whether to call them sane or mad in their devotion to plants.

Critica Botanica

Generic Names (p. 65)

The Ray Society, London, England. 1938

Nuttall, Thomas 1786–1859

English naturalist

Let us not, however, imagine that the science of Botany ends in the mere acquisition of imposed names; we may become acquainted with the structure of plants and their curious economy, like the human anatomist, without troubling ourselves materially with the particular name given to the individual subject. But we cannot proceed far, without employing something like definite language for the several parts of the object under view.

An Introduction to Systematic and Physiological Botany

Part I, Chapter I (pp. 1–2)

Hillard & Brown. Cambridge, England. 1830

Phelps, Almira Hart Lincoln 1793–1884

American educator and writer

The study of Botany seems peculiarly adapted to females; the objects of its investigation are beautiful and delicate; its pursuits, leading to exercise in the open air, are conducive to health and cheerfulness. It is not a sedentary study which can be acquired in the library, but the objects of the science are scattered over the surface of the earth, along the banks of the winding brooks, on the borders of precipices, the sides of mountains, and the depths of the forest. concerns, it is indispensable to the success of the one, and to the comfort of those interested in the other.

Familiar Lectures on Botany, Practical, Elementary and Physiological (5th edition)

Lecture I (p. 14)

F.J. Huntington & Co. New York, New York, USA. 1837

You are now to study Botany; here the objects about which you are to learn, will be placed before you, to *see*, to *touch*, and to *smell*. Thus three of your *senses* will be called upon to aid the *memory* and *understanding*; and as flowers are objects of much beauty and interest, your *imagination* also may be gratified.

Botany for Beginners

Chapter I (p. 9)

Huntington & Savage. 1849

Queneau, Raymond 1903–76

French poet, novelist, and publisher

After nearly taking root under a heliotrope, I managed to graft myself on to a vernal speedwell where my hips and haws were squashed indiscriminately and where there was an overpowering axillary scent. There I ran to earth a young blade or garden pansy whose stalk had run to seed and whose nut, cabbage or pumpkin was surmounted by a capsule encircled by snakeweed. This corny, creeping sucker, transpiring at the palms, nettled a common elder who started to tread his daisies and give him the edge of his bristly ox-tongue, so the sensitive plant stalked off and parked himself. Two hours later, in fresh woods and pastures new, I saw this specimen again with another willowy young parasite who was shooting a line, recommending the sap to switch the top bulbous vegetable ivory element of his mantle blue to a more elevated apex – as an exercise in style.

Exercises in Style

Botanical (pp. 171–172)

New Direction Publishing Corporation. New York, New York, USA. 1981

Richards, Herbert Maul 1871–1928

No biographical data available

Botany consists in the gathering of plants, and the dismembering of them, in connection with the use of a complicated terminology. That is the beginning and end of botany as it is understood by the majority; there is nothing more to be said.

Lectures on Science, Philosophy and Art, 1907–1908

Botany (p. 5)

The Columbia University Press. New York, New York, USA. 1908

Rousseau, Jean-Jacques 1712–78

Swiss-French philosopher

I understand, my dear, that one is vexed to take so much trouble without learning the names of the plants one examines; but I confess to you in good faith that it never entered into my plan to spare you this little chagrin. One pretends that Botany is nothing but a science of words, which only exercises the memory, and only teaches how to give plants names.

Quoted in John Ruskin

Proserpina: Studies of Wayside Flowers (Volume 2)

Book IX, Chapter V (p. 127)

George Allen. London, England. 1882

It is the chain of accessory ideas that makes me love botany

Reveries of the Solitary Walker

Seventh Walk (p. 120)

Penguin Books. London, England. 1979

Schleiden, Matthias Jacob 1804–81

German botanist

Botany, as an inductive science, comprehends the study of the laws and forms of the Vegetable Kingdom. As an experimental science, it takes a very low position; and, at present, embraces but a very narrow circle of actually established facts, few indications of natural laws, and no fundamental principles and ideas by which it might be developed. This becomes very obvious when even the answer to the question, “What is a Plant?” is yet a problem of Botany.

Translated by Edwin Lankester

Principles of Scientific Botany; Or, Botany as an Inductive Science

Introduction (p. 1)

Longman, Brown, Green & Longmans. London, England. 1849

van Rensselaer, Schuyler

No biographical data available

To a person who knows nothing of botany, the trees and flowers which he calls familiar are like the attractive faces that meet him day after day in the street – unnamed faces representing lives and souls which are hidden from his ken.

Art Out-of-doors: Hints on Good Taste in Gardening

Part XVI (p. 333)

Charles Scribner's Sons. New York, New York, USA. 1893

Wakefield, Priscilla 1750–1832

English writer and philanthropist

Botany is a branch of Natural History that possesses many advantages; it contributes to health of body and cheerfulness of disposition, by presenting an inducement to take air and exercise; it is adapted to the simplest capacity, and the objects of its investigation offer themselves without expense or difficulty, which renders them attainable to every rank in life; but with all these allurements, till of late years, it has been confined to the circle of the learned, which may be attributed to those books that treat of it, being principally written in Latin; a difficulty that deterred many, particularly the female sex, from attempting to obtain the knowledge of a science, thus defended, as it were, from their approach.

An Introduction to Botany, in a Series of Familiar Letters, with Illustrative Engravings

Thomas Burnside. Dublin, Ireland. 1796

White, Gilbert 1720–93

English naturalist and cleric

The standing objection to botany has always been, that it is a pursuit that amuses the fancy and exercises the memory, without improving the mind or advancing any real knowledge; and, where the science is carried no farther than a mere systematic classification, the charge is but too true. But the botanist that is desirous of wiping off this aspersion should be by no means content with a list of names; he should study plants philosophically, should investigate the laws of vegetation, should examine the powers and virtues of efficacious herbs, should promote their cultivation; and graft the gardener, the planter, and the husbandman, on the phytologist.

The Natural History and Antiquities of Selborne

Letter XL (pp. 160–161)

Nathaniel Cooke. London, England. 1853

Wordsworth, Dorothy 1771–1855

English author, poet and diarist

The woods extremely beautiful with all autumnal variety and softness. I carried a basket for mosses, and gathered some wild plants. Oh ! that we had a book of botany. All flowers now are gay and deliciously sweet.

Journals of Dorothy Wordsworth (Volume 1)

Friday Morning, 16th (p. 32)

Macmillan & Co Ltd. London, England. 1904

BOTANY, HISTORIAN OF

von Sachs, Julian

No biographical data available

...the task of the historian of Botany...is a very difficult one, for it is only with great labour that he succeeds in

picking the real thread of scientific thought out of an incredible chaos of empirical material.

Translated by E.F. Garnsey

History of Botany (1530–1860)

Preface (p. vi)

At The Clarendon Press. Oxford, England. 1890

BOTANY, STUDY OF

Ruskin, John 1819–1900

English writer, art critic, and social reformer

Balfour's "Manual of Botany." 'Sap,' – yes, at last. "Article 257. Course of fluids in exogenous stems." I don't care about the course just now: I want to know where the fluids come from. "If a plant be plunged into a weak solution of acetate of lead," – I don't in the least want to know what happens. – From the minuteness of the tissue, it is not easy to determine the vessels through which the sap moves." Who said it was? If it had been easy, I should have done it myself. "Changes take place in the composition of the sap in its upward course." I dare say; but I don't know yet what its composition is before it begins going up. "The Elaborated Sap by Mr. Schultz has been called 'latex.'" I wish Mr. Schultz were in a hogshead of it, with the top on. "On account of these movements in the latex, the laticiferous vessels have been denominated cin-enchymatous." I do not venture to print the expressions which I here mentally make use of.

Proserpina (Volume 1)

Lecture III, 14 (pp. 47–48)

John Wiley & Sons. New York, New York, USA. 1886

BOULDER

Burroughs, John 1837–1921

American naturalist and essayist

The grazing or ruminating cattle add a picturesque feature, but the gray granite boulders have been lying there chewing their stony cuds vastly longer. How meditative and contented they look, dreaming the centuries away!

The Writings of John Burroughs (Volume 19)

Chapter II (p. 42)

Houghton, Mifflin. Boston, Massachusetts, USA. 1916

BOWEL MOVEMENT

Hippocrates 460 BCE–377 BCE

Greek physician

The excrement is best which is soft and consistent, is passed at the hour which was customary to the patient when in health, in quantity proportionate to the ingesta; for when the passages are such, the lower belly is in a healthy state.

In Great Books of the Western World (Volume 10)

Hippocratic Writings

The Book of Prognostics, 11 (p. 21)

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

BRACTS

Ruskin, John 1819–1900

English writer, art critic, and social reformer

These, and such undeveloping leaves, wherever they occur, are called "bracts" by botanists, a good word, from the Latin "bractea," meaning a piece of metal plate, so thin as to crackle. They seem always a little stiff, like bad parchment, – born to come to nothing – a sort of infinitesimal fairy-lawyer's deed.

Proserpina: Studies of Wayside Flowers (Volume 2)

Part VII, Chapter I (p. 16)

George Allen. London, England. 1882

BREATH

Peattie, Donald Culross 1898–1964

American botanist, naturalist, and author

This breath of life, so precious and so fated, is to plants and animals a common inspiration. Every leaf of Burnham beeches, of the jungles of Minas Geraes, respire oxygen, day and night, like the panting jungle beasts. Deprived of free oxygen, some cells, bacteria and yeasts and molds, may still breathe, in a sort of smothered ferment. But breathe, in one sense or another, they must. Very low drops the breathing of the frog, frozen at the bottom of the pond, and low the breathing of the butternut, in all its crusty coats. But never while life is in them will it stop.

Flowering Earth

Chapter 4 (p. 46)

G.P. Putnam's Sons. New York, New York, USA. 1939

BRIDGE

Andric, Ivo 1892–1975

Yugoslavian writer

When the angels saw how unfortunate men could not pass those abysses and ravines to finish the work they had to do, but tormented themselves and looked in vain and shouted from one side to the other, they spread their wings above those places and men were able to cross. So men learned from the angels of God how to build bridges, and therefore, after fountains, the greatest blessing is to build a bridge...

The Bridge on the Drina

Chapter XVI (pp. 208–209)

George Allen & Unwin Ltd. London, England. 1959

Broun, Heywood 1888–1939

American writer, journalist, and critic

Men build bridges and throw railroads across deserts, and yet they contend successfully that the job of sewing on a button is beyond them. Accordingly, they don't have to sew buttons.

Seeing Things at Night
Holding a Baby (p. 168)
Harcourt, Brace. New York, New York, USA. 1921

Magna Carta

No township or subject shall be compelled to make bridges at river banks, except those who by ancient usage are legally bound to do so.

In J.C. Dickinson
The Great Charter
Chapter 23 (p. 22)
Published by the Historical Association by G. Philip. London, England. 1955

McGonagall, William ca. 1825–1902
Scottish weaver, actor and poet

Oh! ill fated Bridge of the Silv'ry Tay,
I must now conclude my lay
By telling the world fearlessly and without the least
dismay,
That your central girders would not have given way,
At least many sensible men do say,
Had they been supported on each side with buttresses,
At least many sensible men confesses,
For the stronger we our houses do build,
The less chance of being killed.

Last Poetic Gems Selected from the Works of William McGonagall, Poet and Tragedian
The Tay Bridge Disaster (p. 92)
David Winter & Son. Dundee, Scotland. 1968

Mermin, Norman David 1935–
Mathematician

Bridges would not be safer if only people who knew the proper definition of a real number were allowed to design them.

Topological Theory of Defects
Review of Modern Physics, Volume 51, Number 3, July 1979

Petroski, Henry 1942–
American civil engineer

Designing a bridge or any other large structure is not unlike planning a trip or vacation. The end may be clear and simple: to go from here to there. But the means may be limited only by our imagination.

To Engineer Is Human: The Role of Failure in Successful Design
(p. 64)
St. Martin's Press. New York, New York, USA. 1985

Roebling, John 1806–69
German-American civil engineer

The contemplated work, when constructed in accordance with my designs, will not only be the greatest Bridge in existence, but it will be the greatest engineering work

of this continent, and of the age. Its most conspicuous features, the great towers, will serve as landmarks to the adjoining cities, and they will be entitled to be ranked as national monuments.

Report to the New York Bridge Company
1867

Schuyler, Montgomery 1814–96
American journalist and architectural critic

It so happens that the work which is likely to be our most durable monument, and to convey some knowledge of us to the most remote posterity, is a work of bare utility; not a shrine, not a fortress, not a palace but a bridge.

The Bridge as a Monument
Harper's Weekly, Volume XXVII, Number 137927, May, 1883 (p. 326)

Steinman, D. B.
American engineer

Between two towers soaring high
A parabolic arc is swung
To form a cradle for the stars;
And from this curve against the sky
A span of gleaming steel is hung –
A highway of speeding cars.
Between the cable and the span
A web of silver strands is spaced,
With sky above and ships below
In human dream was born the plan
Of strength and beauty interplaced –
A harp against the sunset glow!
Suspension Bridge
American Engineer, February 22–28, 1953 (p. 33)

Woodson, Thomas T.
No biographical data available

Poor arithmetic will make the bridge fall down just as surely as poor physics, poor metallurgy, or poor logic will.

Introduction to Engineering Design (p. 245)
McGraw-Hill Book Company, Inc. New York, New York, USA. 1966

BROOK

Rooke, Octavius
No biographical data available

If the ocean is like the organ in the world's great orchestra, is not the brook as the sweet flute, whose notes melodious sink into the heart of all?

The Channel Islands: Pictorial, Legendary and Descriptive
Chapter XIV (p. 113)
L. Booth. London, England. 1857

BROWNIAN MOTION

Brown, Robert 1773–1858
Scottish scientist

These [Brownian] motions were such as to satisfy me, after frequently repeated observation, that they arose neither from currents in the fluid, nor from its gradual evaporation, but belonged to the particle itself.

The Miscellaneous Botanical Works of Robert Brown (Volume 1)
A Brief Account of Microscopical Observations made in the Middle of June, July, and August, 1827, on the Particles Contained in the Pollen of Plants (p. 467)

Robert Hardwicke. London, England. 1846

BRUTES

Melville, Herman 1819–91
American novelist

There are unknown worlds of knowledge in brutes; and whenever you mark a horse, or a dog, with a peculiarly mild, calm, deep-seated eye, make sure he is an Aristotle or a Kant, tranquility speculating upon the mysteries in man.

Redburn
Chapter XL (p. 226)
Jonathan Cape. London, England. 1937

BUBBLE

Boys, Charles Vernon 1855–1944
English inventor and physicist

I do not suppose that there is any one in this room who has not occasionally blown a common soap-bubble, and while admiring the perfection of its form, and the marvellous brilliancy of its colours, wondered how it is that such a magnificent object can be so easily produced.

I hope that none of you are yet tired of playing with bubbles, because, as I hope we shall see during the week, there is more in a common bubble than those who have only played with them generally imagine.

Soap-bubbles and the Forces which Mould Them (p. 9)
Society for Promoting Christian Knowledge. London, England. 1896

...a soap bubble is a beautiful thing. It appeals to several senses and to many kinds of minds; it is a source of delight to children, and we who know what somewhat of the mysteries of molecular physics which it helps to reveal look at it with admiration.

Annual Report of the Board of Regents of the Smithsonian Institution (1912)

Experiment with Soap Bubbles (p. 211)
Government Printing Office. Washington, D.C. 1913

Lawrence, D. H. (David Herbert) 1885–1930
English writer

But the pressure was too great. He would have to find something to make good the equilibrium. Something must come with him into the hollow void of death in his soul, fill it up, and so equalise the pressure within to the pressure without. For day by day he felt more and more like a bubble...

Women in Love
Chapter XXIV (p. 308)
The Viking Press. New York, New York, USA. 1950

Maxwell, James Clerk 1831–79
Scottish physicist

On an Etruscan vase in the Louvre figures of children are seen blowing bubbles. Those children probably enjoyed their occupation just as modern children do. Our admiration of the beautiful and delicate forms, growing and developing themselves, the feeling that it is our breath that is turning dirty soap suds into spheres, the fear lest by an irreverent touch we may cause the gorgeous vision to vanish with a sputter of soapy water in our eyes, our wistful gaze as we watch the perfect bubble when it sails away from the pipe's mouth to join, somewhere in the sky, all the other beautiful things that have vanished before it.

Plateau on Soap-Bubbles
Nature, Volume 10, Number 242, Thursday, June 18, 1874 (p. 119)

Mukaiyama, Teruaki 1927–
Japanese chemist and scientific statesman

Vigorous evolution of gas, quick coloration to brown, and the formation of precipitates; there hidden, was the treasure of possibility in the bubbles of foam on the surface, which were observed in the reaction vessel in a corner of our small laboratory! For organic chemists, facing such an unpredictable phenomenon is not uncommon. In flasks, that which can be predicted by thought or discussion with co-workers often happens.

Challenges In Synthetic Organic Chemistry
Prologue (p. 1)
Clarendon Press. Oxford, England. 1990

BUG

Author undetermined

The Lightning-bug has wings of gold.

The June-bug wings of flame.

The Bed-bug has no wings at all.

But he gets there all the same!

Filler material
The Conductor and Brakeman, Volume II, Number 4, April, 1885 (p. 215)

Beard, Dan 1850–1941
American illustrator, writer, and social reformer

Bugs, like women, seem to be very fond of perfume, but, like some of the women, the perfume they use is not always the kind we would choose.

The American Boys' Book of Bugs, Butterflies and Beetles
Fore Talk (p. 10)
J.B. Lippincott & Co. Philadelphia, Pennsylvania, USA. 1915

Bugs, butterflies and beetles are a busy lot, they need watching, they are mischievous little gnomes, but the Great Creator supplied the earth with birds to keep these little insect fairies in subjection.

The American Boys' Book of Bugs, Butterflies and Beetles
Chapter One (p. 31)
J.B. Lippincott & Co. Philadelphia, Pennsylvania, USA. 1915

Beatty, Warren 1937-
American actor, producer, screenwriter, and director

A bug is nothing! A bug does not exist. The word has no meaning. It's only used out of ignorance or malice. You know what a bug is? A bug is a colloquialism which has no basis in reality. Insects include a wide variety of living creatures that fly and crawl, but none of them can be called a bug!

Bugsy
Film (1991)

Billings, Josh (Henry Wheeler Shaw) 1818–85
American writer and humorist

A musketo will fight you in broad dalite, at short range, and giv you a chance tew knock in hiz sides – the flea iz a game bugg, and will make a dash at you even in Broadway – but the bed-bugg iz a garroter, who waits till you strip, and then picks out a mellow place tew eat you. They dassent tackle a man bi dalite, but sneak in, after dark, and chaw him while he iz fast asleep.

Josh Billings' Wit and Humor
Bed Bugs (p. 111)
George Routledge & Sons. London, England. 1874

Whenever i cum akros enny bug, that i dont know what they waz built for, i dont blame the bug.

I hav grate phaith in ennything that kreeps, krawls, or even wiggles, and tho i haint been able tew satisfy miself all about the usefulness ov bed bugs, musketoze, and striped snaix, i hav phaith that Divine Providence did not make them in vain.

Josh Billings' Wit and Humor
The Lady Bug (p. 143)
George Routledge & Sons. London, England. 1874

Carryl, Charles Edward 1841–1920
American writer

...we carry home as prizes Funny bugs, of handy sizes,

Just to give the day a scientific tone.

In Edward Hodnett (ed., rev. edition, 1967)
Poems to Read Aloud
Davy and the Goblin, l. 40–42
W.W. Norton & Company, Inc. New York, New York, USA. 1967

Cuppy, Will 1884–1929
American humorist and critic

You are a bug only if you belong to the order Hemiptera, formerly the suborder Heteroptera. Is that clear now?

How to Attract the Wombat
The Ladybug (fn 5, p. 164)
Rinehart & Company, Inc. New York, New York, USA. 1949

Dekker, Thomas 1570–1632
English dramatist

We have bugs sir.
The Dramatic Works of Thomas Dekker: The Virgin Martir (p. 56)
Printed by B.A. for Thomas. London, England. 1622

Glover, Townend 1813–83
American entomologist

From red-bugs and bed-bugs, from sand-flies and land-flies,
Mosquitoes, gallnippers and fleas,
From hog-ticks and dog-ticks, from hen-lice and men-lice,
We pray thee, good Lord, give us ease.

In Arnold Mallis
American Entomologist
Chapter 3 (pp. 64–65)
Rutgers University Press. New Brunswick, New Jersey, USA. 1971

Harding, George Canady 1829–1881
Writer

And then the bugs; there were round bugs, and flat bugs, and oblong bugs, and spiral bugs – humbugs and bugaboos – bugs emitting a deadly stench when, as invariably happened, they procured themselves to be crushed.

The Miscellaneous Writings of George C. Harding
Shifting Scenes from the Drama of the Late War (p. 283)
Carlton & Hollenbeck. Indianapolis, Indiana, USA. 1882

Holland, W. J.
No biographical data available

When the moon shall have faded out from the sky, and the sun shall shine at noonday a dull cherry-red, and the seas shall be frozen over, and the ice-cap shall have crept downward to the equator from either pole, and no keels shall cut the waters, nor wheels turn in mills, when all cities shall have long been dead and crumbled into dust, and all life shall be on the very last verge of extinction on this globe; then, on a bit of lichen, growing on the bald rocks beside the eternal snows of Panama, shall be seated a tiny insect, preening its antenna in the glow of the worn-out sun, representing the sole survival of animal life on this our earth, – a melancholy “bug”.

The Moth Book: A Popular Guide to a Knowledge of the Moths of North America
The End (p. 445)
Doubleday, Page & Company. New York, New York, USA. 1904

Little, Arthur D. 1863–1935

American chemist

“Ladybird, ladybird, fly away home,” becomes impossible when one is forced to address the prettily spotted beetle as *Coccinella dipunctata*.

The Fifth Estate (p. 6)

The Franklin Institute. Philadelphia, Pennsylvania, USA. 1924

Marquis, Don 1878–1937

American newspaperman, poet, and playwright

if all the bugs
in all the worlds
twixt earth and betelgoose
should sharpen up
their little stings
and thrun their feelings loose
they soon would show
all human beans

in saturn

earth

or mars

their relative significance

among the spinning stars

the lives and time of archy & mehitabel

archy turns revolutionist (p. 226)

Doubleday Doran & Co. Garden City, New York, USA. 1934

Morley, Margaret Warner 1858–1923

American biologist, educator, and writer

They call every insect a “bug,” but bugs are bugs, flies are flies, ants are ants, and neither flies nor ants are bugs. Indeed, no insects are bugs – excepting just bugs!

The Insect Folk

The Great Bug Family (p. 115)

Ginn & Co. Boston, Massachusetts, USA. 1903

Oemler, Marie Conway 1879–1932

American novelist

“Where the Sam Hill,” he blazed, “do all these footy little devils come from, anyhow? Where am I to put a beast of a bug when the next one that’s exactly like it is entirely different the next time you look at it? There’s too much beginning and no end at all to this game!”

Slippy Magee, Sometimes Known as Butterfly Man (p. 72)

Grosset & Dunlap. New York, New York, USA. 1921

Prelutsky, Jack 1940–

American poet

Bugs! Bugs!
I love bugs,
yes I truly do,

great big pink ones,
little green stink ones,
yellow bugs and blue.
I put you in my pockets,
and I wear you in my hair.
You are my close companions,
I take you everywhere.

A Pizza the Size of the Sun: Poems

Bugs! Bugs!

Greenwillow Books. New York, New York, USA. 1996

Southall, John

No biographical data available

A Bugg’s Body is shaped and shelled and the Shell as transparent and finely striped as the most beautiful amphibious Turtle; has six legs most exactly shaped, jointed and bristled as the Legs of a Crab. Its Neck and Head much resembles a Toad’s. On its Head are three Horns picqued and bristled; and at the end of their Nose they have a Sting sharper and much smaller than a Bee’s. The Use of their Horns is in Fight to assail their Enemies, or defend themselves. With the Sting they penetrate and wound our Skins, and then (tho’ the Wound is so small as to be almost imperceptible) they thence by Suction extract their most delicious Food, our Blood.

A Treatise of Buggs (p. 19)

1730

Trollope, Anthony 1815–82

English novelist

I hope men and women will not give way to bugs and fleas ...

Lady Anna (Volume 1)

Chapter IV (p. 48)

Chapman & Hall, Ltd. London, England. 1874

BUILD**Author undetermined**

Those who personally dominate are heroes for the hour; those who build are immortal.

Journal of Engineering Education, Volume 30, Number 3, November, 1939 (p. 314)**Bronowski, Jacob** 1908–74

Polish-born British mathematician and polymath

The most powerful drive in the ascent of man is his pleasure in his own skill. He loves to do what he does well and, having done it well, he loves to do it better. You see it in his science. You see it in the magnificence with which he carves and builds, the loving care, the gaiety,

the effrontery. The monuments are supposed to commemorate kings and religions, heroes, dogmas, but in the end the man they commemorate is the builder.

The Ascent of Man

The Grain in the Stone (p. 116)

Little, Brown & Co. Boston, Massachusetts, USA. 1973

Those who personally dominate are heroes for the hour; those who build are immortal.

Journal of Engineering Education, Volume 30, Number 3, November, 1939 (p. 314)

Longfellow, Henry Wadsworth 1807–82

American poet

Michael A: Ah, to build, to build!
That is the noblest art of all the arts.
Painting and sculpture are but images,
Are merely shadows cast by outward things
On stone or canvas, having in themselves
No separate existence. Architecture,
Existing in itself, and not seeming
A something it is not, surpasses them
As substance shadow.

The Poetical Works of Henry Wadsworth Longfellow

Michael Angelo, III, San Silvestro

Houghton Mifflin Company. Boston, Massachusetts, USA. 1883

...to build, to build That is the noblest art of all the arts.
Painting and sculpture are but images, Are merely shadows cast by outward things
On stone or canvas, having in themselves No separate existence. Architecture, Existing in itself, and not in seeming
A something it is not, surpasses them As substance shadow.

The Complete Poetical Works of Henry Wadsworth Longfellow

Michael Angelo (p. 420)

Houghton Mifflin & Co. Boston, Massachusetts, USA. 1899

Ruskin, John 1819–1900

English writer, art critic, and social reformer

Therefore when we build, let us think that we build (public edifices) forever. Let it not be for present delight, nor for present use alone, let it be such work as our descendants will thank us for, and let us think, as we lay stone to stone, that a time is to come when those stones will be held sacred because our hands have touched them, and that men will say as they look upon the labor and wrought substance of them, “See!”

True and the Beautiful in Nature, Art, Morals and Religion, Selected from the Works of John Ruskin

Part 3, The Lamp of Memory (pp. 142–143)

John Wiley & Sons, Inc. New York, New York, USA. 1860

To build, literally to confirm, is by common understanding to put together and adjust the several pieces of any edifice or receptacle of a considerable size. Thus we have church building, house building, ship building, and coach building.

The Seven Lamps of Architecture

Chapter I (p. 7)

John Wiley & Son. New York, New York, USA. 1865

Shakespeare, William 1564–1616

English poet, playwright, and actor

When we mean to build,
We first survey the plot, then draw the model.
And when we see the figure of the house,
Then must we rate the cost of the erection,
Which if we find outweighs ability,
What do we then but draw anew the mode
In fewer offices, or at least desist
To build at all?

In Great Books of the Western World (Volume 26)

The Plays and Sonnets of William Shakespeare (Volume 1)

Second Part of King Henry the Fourth

Act I, Scene iii, l. 41

Encyclopædia Britannica, Inc. Chicago, Illinois, USA. 1952

Wooten, Henry

No biographical data available

In *Architecture* as in all other *Operative Arts*, the end must direct the *Operation*.

The *end* is to build well.

Well building hath three Conditions.

Commodities, Firmness, and Delight.

The Elements of Architecture

The I. part (p. 1)

Printed by John Bill. London, England. 1624

BUILDER

Ruskin, John 1819–1900

English writer, art critic, and social reformer

No person who is not a great sculptor or painter can be an architect. If he is not a sculptor or painter, he can only be a builder.

True and the Beautiful in Nature, Art, Morals and Religion, Selected from the Works of John Ruskin

Part 4, Sculpture (p. 209)

John Wiley & Sons, Inc. New York, New York, USA. 1860

But of them [the builders], and their life, and their toil upon the earth, one reward, one evidence, is left to us in those gray heaps of deep-wrought stone. They have taken with them to the grave their powers, their honors, and their errors; but they have left us their adoration.

The Seven Lamps of Architecture

Chapter I (p. 24)

John Wiley & Son. New York, New York, USA. 1865

In no art is there closer connection between our delight in the work, and our admiration of the workman's mind, than in architecture, and yet we rarely ask for a builder's name.

The Stones of Venice
Chapter II (p. 38)
Smith, Elder & Co. London, England. 1873

BUILDING

de Staël (Anne-Louise-Germaine),

Mme. 1766–1817
French romantic writer

The sight of such a building [St. Peter's Cathedral] is like a ceaseless, changeless melody ...

Translated by Isabel Hill
Corinne
Chapter II (p. 62)
New York, New York, USA. 1876

Disraeli, Benjamin, 1st Earl

of Beaconsfield 1804–81
English prime minister, founder of Conservative Party, and novelist

Nothing more completely represents a nation than a public building.

Tancred, Or The New Crusade
Chapter X (p. 112)
Longmans, Green & Co. London, England. 1900

Hertzberger, Herman 1932–
Dutch architect

We will have to accept that buildings, like household and other appliances, are showing less and less of their contents and their workings, and starting to behave increasingly like urban containers.

Space and the Architect: Lessons in Architecture 2
Chapter 4 (p. 102)
010 Publishers. Rotterdam, The Netherlands. 2000

Ruskin, John 1819–1900
English writer, art critic, and social reformer

All that is fantastic in form, or frivolous in detail, annihilates the aristocratic air of a building: it at once destroys its sublimity and size, besides awakening, as is almost always the case, associations of a mean and low character.

The Poetry of Architecture: Cottage, Villa, Etc
The Cottage (p. 26)
John Wiley & Sons. New York, New York, USA. 1877

Everything about it [a building] should be natural, and should appear as if the influences and forces which were in operation around it had been too strong to be resisted, and had rendered all efforts of art to check their power, or conceal the evidence of their action, entirely unavailing.

The Poetry of Architecture: Cottage, Villa, Etc
The Cottage (p. 44)
John Wiley & Sons. New York, New York, USA. 1877

...the material which Nature furnishes, in any given country, and the form which she suggests, will always render the building the most beautiful ...

The Poetry of Architecture: Cottage, Villa, Etc
The Cottage (p. 48)
John Wiley & Sons. New York, New York, USA. 1877

...the more polished the mind of its designer, the less national will be the building; for its architect will be led away by a search after a model of ideal beauty, and will not be involuntarily by deep-rooted feelings, governing irresistibly his heart and hand.

The Poetry of Architecture: Cottage, Villa, Etc
The Villa (p. 82)
John Wiley & Sons. New York, New York, USA. 1877

Statham, H. Heathcote 1839–1924
Architect

...a building ought to express in its external design its internal planning and arrangement; in other words, the architectural design should arise out of the plan and disposition of the interior, or be carried on concurrently with it, not designed as a separate problem.

Architecture for General Readers
Architecture for General Readers (p. 5)
Charles Scribner's Sons. New York, New York, USA. 1896

BUILDINGS

Gloag, John 1896–1981
Architectural writer

Architecture cannot lie, and buildings, although inanimate, are to that extent morally superior to men.

Presentation
The Significance of Historical Research in Architectural and Industrial Design
Royal Society of Arts, 20 March, 1963

Hugo, Victor 1802–85
French author, lyric poet, and dramatist

Great edifices, like great mountains, are the work of ages.

Notre-Dame de Paris
Book III, Chapter 1 (p. 107)
J.M. Dent & Sons Ltd. London, England. 1910

Ruskin, John 1819–1900
English writer, art critic, and social reformer

Better the rudest work that tells a story or records a fact, than the richest without meaning. There should not be a single ornament put upon great civic buildings, without some intellectual intention.

True and the Beautiful in Nature, Art, Morals and Religion, Selected from the Works of John Ruskin

Part 3, The Lamp of Memory (p. 142)

John Wiley & Sons, Inc. New York, New York, USA. 1860

...we require from buildings, as from men, two kinds of goodness: first, the doing their practical duty well: then that they be graceful and pleasing in doing it; which last is itself another form of duty.

The Works of John Ruskin

The Stones of Venice (Volume 1)

Chapter II, Section 1 (p. 36)

John Wiley & Sons, Inc. New York, New York, USA. 1887

BUTTERFLY NET

Gibson, William Hamilton 1850–96

American illustrator, author, and naturalist

My butterfly-net and pocket magnifying-glass are rare companions for a walk in the country.

Sharp Eyes: A Rambler's Calendar

The Sweep-Nest Harvest

July 21st (p. 117)

Harper & Brothers Publishers. New York, New York, USA. 1900

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A Collection of Approximately 27,000 Quotations

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Zoology

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