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Science, Serendipity and Success: A Historical Perspective and Critical Appraisal

Sher Ali[1*], Farha Bano[2] and Anam Farooqui[3]
[1]Vice Chancellor's Office, Era University, Sarfaraz Ganj, Hardoi Road, Lucknow, Uttar Pradesh, India
[2]Department of Happiness, Era University, Sarfaraz Ganj, Hardoi Road, Lucknow, Uttar Pradesh, India
[3]Biomedical Informatics Center (BIC), ICMR National Institute for Research in Reproductive and Child Health, Parel, Mumbai, Maharashtra, India
[*]Corresponding Author: profsali55@gmail.com

Abstract: Those of us related to academics whether it is science, research, innovation or any other sub-disciplines, desire to achieve success and feel happy and satisfied. The rate of success, satisfaction and ultimate happiness may be highly varying owing to our perceptional heterogeneity. However, there are some rules if one follows, success becomes feasible and even under most challenging conditions, it may not be impossible to achieve. Historically, many notable discoveries have been attributed to serendipity. Nonetheless, in order to reach the level of serendipity, creation of an environment that allows serendipity to sprout at the right time under the right condition is highly crucial. This situation warrants imagination, constant efforts and never to give up attitudes. Present chapter explores the nuances of serendipity in the light of historical perspective and examines science, serendipity and success in their larger realms. Today, we live in a world where information technology has superseded every other field. In addition, deep learning, machine learning and artificial intelligence have impacted the generation, annotation, accumulation and dissipation of knowledge in a big way. Cloud computing has added a newer dimension to the conventional concept of computing involving different, more advanced algorithms, engaging technology, tools and resource intensive approaches. Many of us are at a loss to deal with the huge influx of information even in a highly specialized area of a subject. One possibility may be that we manage our desired dose of information in a staggered manner to be able to make the best possible use of it without losing our focus from the main theme. The other approach is to use AI for our work to lessen the burden. These nuances are useful to almost all the branches of science and literature including humanities, theology, languages, international relation, judiciary, banking, defence, telecommunication, architecture, engineering, space technology and Medical Science. A large number of disciplines have been listed in this article with their immediate succinct meanings. It is envisaged that this article would be thought provoking, entice and engage people who desire to get the best of the tool, techniques and technology without feelings burnt out in their areas of specialization. Achievement of intellectualism should be the objectives of every educated person so that the society in general and country in particular becomes a hub of knowledge to achieve the goal of Viksit Bharat.

Keywords: Innovation, Happiness, Knowledge generation, Satisfaction, Science, Serendipity, Success.

I. Introduction

Modern scientific study is divided into three major disciplines, namely Physical, Life, and Earth Sciences encompassing the realm of all Natural Sciences. However, Earth Sciences are often included within the Physical Sciences. In Latin, Science means knowledge. In the broader and philosophical terms, Science covers a systematic enterprise that builds and organizes knowledge in the form of testable explanation and predictions about a subject. Modern science has several familiar branches. Natural Science deals with Biology, Chemistry, Physics, Astronomy and Earth Science. All this science covers nature in the broadest sense, delineating the same from social sciences. Similarly, social science deals with psychology, sociology, economics, history, geography. These branches enable studies of people and society. We have other formal sciences encompassing mathematics, logic, theoretical computer sciences which study abstract concepts. Many subjects or disciplines are enriched by the people because of their deep indulgence in a chosen field. However, pursuance of knowledge itself enriches a person resulting in his intellectual upliftment, personal and professional development. Yet another field covers engineering and medicine, which are described as applied sciences. When we look at medicine, it has become highly specialized and therefore one single person cannot become an expert in all the branches of modern medical sciences. There are a large number of disciplines that are also placed in the science category but they deal more with humanities. We have attempted to list all the known disciplines with their brief meaning. A careful perusal of literature indicates that there are 737 branches that have been faithfully listed in the literature.

We have attempted to provide a bird eye view of these disciplines with the assumption that this information will be useful for students and young faculty members to search, pursue and contribute in these areas of science and humanities as per their aptitudes.

The Table I gives an overview of the difference branches of science shown alphabetically [1].

Table I: Overview of the Different Branches of Science

Sr. No.	*Category*	*Field*	*Description*
1	Applied Sciences	Aristology	Science or art of dining.
2		Gastronomy	Study of fine dining.
3		Magirics	Art of cookery.
4		Enology	Study of wines.
5		Bromatology	Study of food.
6		Zythology	Study of beer.
7		Zymurgy	Branch of chemistry dealing with brewing and distilling.
8		Zymology	Science of fermentation.
9		Methyology	Study of alcohol.
10		Tegestology	Study and collecting of beer mats.
11		Dactylography	Study of fingerprints.
12		Dermatoglyphics	Study of skin patterns and fingerprints.
13		Pharology	Study of lighthouses.
14		Gnotobiology	Study of life in germ-free conditions.
15		Castrametation	Art of designing a camp.
16		Stratography	Art of leading an army.
17		Chirocosmetics	Beautifying the hands; art of manicure.
18		Cosmetology	Study of cosmetics.
19		Navigation	Study of controlling a movement of a vehicle from one place to another.
20	Arts and Design	Pyrgology	Study of towers
21		Naology	Study of church or temple architecture.
22		Ichnography	Art of drawing ground plans; a ground plan.
23		Aerology	Study of the atmosphere.
24		Atmology	The science of aqueous vapour.
25		Dendrochronology	Study of tree rings.
26		Geography	Study of surface of the earth and its inhabitants.
27		Geology	Study of the rocks of a planet.
28		Pelology	Study of mud.
29		Geochemistry	Study of chemistry of the Earth’s crust.
30	Arts and Humanities	Manège	Art of horsemanship.
31		Musicology	Study of music.
32		Hymnography	Study of writing hymns.
33		Hymnology	Study of hymns.
34		Organology (musicology)	Study of musical instruments in relation to history, culture, construction, acoustic properties, and classification.
35		Psalligraphy	Art of paper-cutting to make pictures.
36		Xylography	Art of engraving on wood.
37		Toreutics	Study of artistic work in metal.

Sr. No.	*Category*	*Field*	*Description*
38		Sciagraphy	Art of shading.
39		Pyrography	Study of wood burning.
40		Glyptography	Art of engraving on gems.
41		Ciselure	Art of chasing metal.
42		Chalcography	Art of engraving on copper or brass.
43		Chalcotriptics	Art of taking rubbings from ornamental brasses.
44		Diagraphics	Art of making diagrams or drawings.
45		Kalology	Study of beauty.
46		Ethnochoreology	Study of dances and its implication in culture.
47		Folkloristics	Study of folklore and fables.
48		Ethnomusicology	Study of comparative musical systems.
49		Glyptology	Study of gem engravings.
50		Iconography	Study of drawing symbols.
51		Iconology	Study of icons; symbols.
52		Pyroballogy	Study of artillery.
53		Melology	Study of music; musicology.
54	Behavioral Sciences	Ergonomics	Study of people at work.
55		Osmics	Scientific study of smells.
56		Osmology	Study of smells and olfactory processes.
57		Osphresiology	Study of the sense of smell.
58	Cultural Studies	Notaphily	Study and collecting of bank-notes and cheques.
59		Timbrology	Study of postage stamps.
60		Enigmatology	Study of enigmas (puzzles).
61		Escapology	Study of freeing oneself from constraints.
62		Labeorphily	Collection and study of beer bottle labels.
63		Peristerophily	Pigeon-collecting.
64		Phillumeny	Collecting of matchbox labels.
65		Floristry	Art of cultivating and selling flowers.
66	Earth Sciences	Meteorology	Study of weather.
67		Anemology	Study of wind.
68		Microclimatology	Study of local climates.
69		Cryobiology	Study of life under cold conditions.
70		Aerobiology	Study of airborne organisms.
71		Aeropalynology	Study of pollens and spores in the atmosphere.
72		Koniology	Study of atmospheric pollutants and dust.
73		Forestry	Study of the creation, management, use, conservation, and repair of forests and associated resources.
74		Garbology	Study of garbage.
75		Chorology	Science of the geographic description of anything.
76		Topography	Study of the shape and features of land surfaces.
77		Eremology	Study of deserts.
78		Cartography	Science of making maps and globes.
79		Biogeochemistry	Study of chemistry of the surface of the Earth.

Sr. No.	*Category*	*Field*	*Description*
80		Gromatics	Science of surveying.
81		Hypsography	Science of measuring heights.
82		Agrogeology	Study of agrominerals.
83		Metallogeny	Study of the origin and distribution of metal deposits.
84		Mineralogy	Study of minerals.
85		Petrology	Study of rocks.
86		Sedimentology	Study of sediment.
87		Stratigraphy	Study of geological layers or strata.
88		Speleology	Study and exploration of caves.
89		Volcanology	Study of volcanoes.
90		Tectonics	Science of structure of objects, buildings, and landforms.
91		Geomorphogeny	Study of the characteristics, origins, and development of landforms.
92		Gemmology	Study of gems and jewels.
93		Oryctology	Mineralogy or paleontology.
94		Geomorphology	Study of landforms and landform evolution.
95		Orology	Study of mountains.
96		Geochronology	Study of measuring geological time.
97		Seismology	Study of earthquakes.
98		Fluviology	Study of watercourses.
99		Hydrography	Study of investigating bodies of water.
100		Oceanography	Study of oceans.
101		Oceanology	Study of oceans.
102		Limnology	Study of bodies of fresh water.
103		Halieutics	Study of fishing.
104		Siderology	Study of iron and its alloys, including steel.
105		Cyclonology	Study of tropical cyclones, e.g. hurricanes.
106		Tempestology	Study of tropical cyclones, e.g., hurricanes.
107		Turbology	Study of tornadoes.
108		Nephology	Study of clouds.
109		Climatology	Study of climate.
110		Hydrometeorology	Study of atmospheric moisture.
111		Hyetology	Science of rainfall.
112		Bathymetry	Study of underwater depth of ocean floors or lake floors.
113		Thalassography	Science of the sea.
114		Tidology	Study of tides.
115		Micropalaeontology	Study of microscopic fossils.
116		Palaeontology	Study of fossils.
117		Zoogeology	Study of fossil animal remains.
118		Ichnology	Science of fossilized footprints.
119		Palaeobiology	Study of fossil plants and animals.
120		Paleobotany	Study of ancient plants.
121		Palaeoichthyology	Study of ancient fish.
122		Paleo-osteology	Study of ancient bones.
123		Edaphology	Study of soils.

Sr. No.	*Category*	*Field*	*Description*
124	Engineering and Technology	Aerodonetics	Science or study of gliding.
125		Aeronautics	Study of navigation through air or space.
126		Avionics	Science of electronic devices for aircraft.
127		Barodynamics	Science of the support and mechanics of bridges.
128		Engineering studies	Study of engineering.
129		Robotics	Deals with the designing, construction, and operation of robots.
130		Zygology	Science of joining and fastening.
131		Solid mechanics	Study of behaviour of solid materials.
132		Tribology	Study of friction and wear between surfaces.
133		Molinology	Study of mills and milling.
134		Rocket science	Study of building and designing rockets.
135		Chrysology	Study of precious metals.
136		Docimology	Art of assaying (testing the quality of metals).
137		Fracture mechanics	Study of the propagation of cracks in materials.
138	Humanities	Pogonology	Study of beards.
139		Ludology	Study of games.
140		Archaeology	Study of human material remains.
141		Momilogy	Study of mummies.
142		Zooarchaeology	Study of animal remains from archaeological sites.
143		Egyptology	Study of ancient Egypt.
144		Chirography	Study of handwriting or penmanship.
145		Scripophily	Collection of bond and share certificates.
146		Media Studies	Study of mass media.
147		Museology	Study of museums.
148		Mythology	Study of myths; fables; tales.
149		Dialectology	Study of dialects.
150		Etymology	Study of origins of words.
151		Glossology	Study of language; study of the tongue.
152		Grammatology	Study of systems of writing.
153		Graphemics	Study of systems of representing speech in writing.
154		Idiomology	Study of idiom, jargon or dialect.
155		Lexicology	Study of words and their meanings.
156		Lexigraphy	Art of definition of words.
157		Linguistics	Study of language.
158		Onomastics	Study of proper names.
159		Orthography	Study of spelling.
160		Phraseology	Study of phrases
161		Prosody	Study of versification
162		Semantics	Study of meaning.
163		Semantology	Science of meanings of words.
164		Semasiology	Study of meaning; semantics.
165		Syntax	Study of sentence structure.

Sr. No.	*Category*	*Field*	*Description*
166		Tonetics	Study of pronunciation.
167		Runology	Study of runes, particularly the characters and symbols used in ancient languages.
168		Semiotics	Study of signs and symbols.
169		Toponymics	Study of place-names.
170		Gigantology	Study of giants.
171		Agnoiology	Study of ignorance.
172		Alethiology	Study of truth.
173		Archelogy	Study of first principles.
174		Aretaics	Science of virtue.
175		Autology	Scientific study of oneself.
176		Axiology	Science of the ultimate nature of value.
177		Epistemology	Study of grounds of knowledge.
178		Gnosiology	Study of knowledge; philosophy of knowledge.
179		Mereology	Study of part-whole relationships.
180		Metaphysics	Study of principles of nature and thought.
181		Neutrosophy	Study of the origin and nature of philosophical neutralities.
182		Paradoxology	Study of paradoxes.
183		Philosophy	Science of knowledge or wisdom
184		Sophiology	Science of ideas.
185		Teleology	Study of final causes; analysis in terms of purpose.
186		Metascience	Study of science itself, its methods, and foundations.
187		Significs	Science of meaning.
188		Ideogeny	Study of origins of ideas.
189		Noology	Science of the intellect.
190		Deontology	Theory or study of moral obligation.
191		Nomology	The science of the laws; especially of the mind.
192		Logics	Study of correct reasoning.
193		Ontology	Science of pure being; the nature of things.
194		Pataphysics	Science of imaginary solutions.
195		Phenomenology	Study of phenomena.
196		Pisteology	Science or study of faith.
197		Ideology	Science of ideas; system of ideas used to justify behavior.
198		Irenology	Study of peace.
199		Micrology	Study or discussion of trivialities.
200		Schematonics	Art of using gesture to express tones.
201		Sociolinguistics	Study of how society affects language.
202		Paroemiology	Study of proverbs.
203		Punnology	Study of puns.
204		Philology	Study of ancient texts; historical linguistics
205		Onomasiology	Study of nomenclature.
206		Orthoepy	Study of correct pronunciation.
207		Phonology	Study of speech sounds.

Sr. No.	*Category*	*Field*	*Description*
208		Dactylology	Study of sign language.
209		Stylometry	Studying literature by means of statistical analysis.
210		Stemmatology	Study of relationships between texts.
211		Textology	Study of the production of texts.
212		Codicology	Study of manuscripts.
213		Metrics	Study of versification.
214		Symbology	Study of symbols.
215		Semiology	Study of signs and signals.
216		Theology	Study of religion.
217		Soteriology	Study of theological salvation.
218		Thaumatology	Study of miracles.
219		Diabology	Study of devils.
220		Eschatology	Study of death; final matters.
221		Hamartiology	Study of sin.
222		Ecclesiology	Study of church affairs.
223		Hagiology	Study of saints.
224		Heresiology	Study of heresies.
225		Hierology	Science of sacred matters.
226		Liturgiology	Study of liturgical forms and church rituals.
227		Mariology	Study of the Virgin Mary.
228		Sindonology	Study of the Shroud of Turin.
229		Patrology	Study of early Christianity
230		Typography	Art of printing or using type.
231		Historiography	Study of writing history.
232		Historiology	Study of history.
233		Vexillology	Study of flags.
234		Genealogy	Study of descent of families.
235		Diplomatics	Science of deciphering ancient writings and texts.
236		Papyrology	Study of paper.
237		Numismatics	Study of coins.
238		Deltiology	Collection and study of picture postcards.
239	Interdisciplinary	Biometrics	Study of biological measurement for security purposes.
240		Pyrotechnics	Study of combustion through fire or explosions
241		Horography	Art of constructing sundials or clocks.
242		Gnomonics	The art of measuring time using sundials.
243		Campanology	Study of bells.
244		Turnery	Art of turning in a lathe.
245		Ethonomics	Study of economic and ethical principles of a society.
246		Hedonics	Part of ethics or psychology dealing with pleasure.
247		Loxodromy	Study of sailing along rhumb-lines.
248		Synectics	Study of processes of invention.
249		Methodology	Study or description of methods.
250		Scientific modelling	Study of application of models to understand a particular problem.

Sr. No.	Category	Field	Description
251		Futurology	Study of the future.
252		Neuropsychology	Study of relation between brain and behavior.
253		Rhochrematics	Science of inventory management and the movement of products.
254		Selenodesy	Study of the shape and features of the Moon.
255		Nautics	Study and art of navigation.
256		Metallography	Study of the structure and constitution of metals.
257		Vitrics	Study of glassy materials; glassware.
258		Metallurgy	Study of alloying and treating metals.
259		Cognitive science	Study of cognitive processes.
260		Psychophysics	Study of link between mental and physical processes
261		Sexology	Study of sexual behaviour.
262		Nanotechnology	Study of nanites, nanomaterials, and nanoscale processes.
263		Urbanology	Study of cities.
264		Gender Studies	Study of gender.
265		Philematology	Act or study of kissing.
266		Proxemics	Study of man's need for personal space.
267		Agonistics	Art and theory of prize-fighting.
268		Toxophily	Love of archery; archery; study of archery.
269		Homiletics	Art of preaching.
270		Taxidermy	Art of curing and stuffing animals.
271		Anthrozoology	Study of human-animal interaction.
272	Life Sciences	Vinology	Scientific study of vines and winemaking.
273		Acanthochronology	Study of cactus spines grown in time-ordered sequence.
274		Agrostology	Science or study of grasses.
275		Algology (Botany)	Study of algae.
276		Batology	The study of brambles.
277		Botany	Study of plants.
278		Bryology	Study of mosses and liverworts.
279		Caricology	Study of sedges.
280		Carpology	Study of fruit.
281		Graminology	Study of grasses.
282		Microphytology	Study of very small plant life.
283		Muscology	Study of mosses.
284		Phytology	Study of plants; botany.
285		Pteridology	Study of ferns
286		Spermology	Study of seeds.
287		Sphagnology	Study of peat moss.
288		Melissopalynology	Study of honey.
289		Dendrology	Study of trees.
290		Phycology	Study of algae and seaweeds.
291		Lichenology	Study of lichens.
292		Palynology	Study of pollen
293		Orchidology	Study of orchids.

Sr. No.	*Category*	*Field*	*Description*
294		Xylology	Study of wood.
295		Autecology	Study of ecology of one species.
296		Bioecology	Study of interaction of life in the environment.
297		Bionomics	Study of organisms interacting in their environments.
298		Mesology	Ecology; study of ecosystems and environment.
299		Synecology	Study of ecological communities.
300		Terrestrial ecology	Study of terrestrial environment.
301		Telmatology	Study of swamps.
302		Agroecology	Study of ecological processes applied to agricultural systems.
303		Aquatic Ecology	Study of aquatic environment.
304		Ecology	Study of environment.
305		Systematics	Study of the diversification of living forms, both past and present.
306		Taxonomy	Study of plant, animals, and microorganisms' classification.
307		Zoophytology	Study of plant-like animals.
308		Phenology	Study of organisms as affected by climate.
309		Phylogeny (or phylogenetics)	Study of evolutionary relationships and history among or within groups of organisms
310		Silvics	Study of tree's life.
311		Karyology	Study of cell nuclei.
312		Heredity	Study of passing of traits from parents to offspring.
313		Molecular Biology	Study of the molecular basis of biological activity in and between cells.
314		Genetics	Study of genes.
315		Ctetology	Study of the inheritance of acquired characteristics.
316		Dysgenics	Study of racial degeneration.
317		Immunogenetics	Study of genetic characteristics of immunity.
318		Genesiology	Study of reproduction and heredity.
319		Agrobiology	Study of plant nutrition; soil yields.
320		Agrology	Study of agricultural soils.
321		Agronomics	Study of productivity of land.
322		Geoponics	Study of agriculture.
323		Horticulture	Study of gardening.
324		Agricultural Chemistry	Study of influence in chemical processes in plants.
325		Thremmatology	Science of breeding domestic animals and plants.
326		Pomology	Study of fruit-growing
327		Magnanerie	Art of raising silkworms.
328		Biochemistry	Study of chemical processes within and relating to living organisms.
329		Immunochemistry	Study of chemistry of the immune system.
330		Enzymology	Study of enzymes.
331		Anthropobiology	Study of human biology.
332		Biology	Study of life.
333		Auxology	Science of growth.

Sr. No.	*Category*	*Field*	*Description*
334		Geratology	Study of decadence and decay.
335		Xenobiology	Study of biological systems that do not exist in nature.
336		Somatology	Science of substances.
337		Zoology	Study of animals.
338		Morphology	Study of forms and the development of structures.
339		Photobiology	Study of effects of light on organisms.
340		Mycology	Study of fungi.
341		Urenology	Study of rust molds.
342		Nymphology	Study of nymphs.
343		Zoophysics	Physics of animal bodies.
344		Zoonomy	Study of animal physiology.
345		Zoophysiology	Study of physiology of animals.
346		Eccrinology	Study of excretion.
347		Biopsychology	Application of the science of biology to the study of psychology.
348		Psychobiology	Study of biology of the mind.
349		Hygienics	Study of sanitation; health.
350		Epidemiology	Study of diseases and epidemics.
351		Hygiology	Hygienics; study of cleanliness.
352		Spongology	Study of sponges.
353		Hydrobiology	Study of aquatic organisms.
354		Limnobiology	Study of freshwater ecosystems.
355		Marine Biology	Study of the ocean’s ecosystem.
356		Protistology	Study of protists.
357		Ombrology	Study of rain.
358		Bacteriology	Study of bacteria.
359		Microbiology	Study of microscopic organisms.
360		Virology	Study of viruses.
361		Microbial Ecology	Study of microbial environment.
362		Connectomics	Study of connectomes.
363		Neuroscience	Study of development, work, and structure of the nervous system.
364		Neurobiology	Study of anatomy of the nervous system.
365		Caliology	Study of bird’s nests.
366		Plumology	Study of feathers
367		Pterylology	Study of distribution of feathers on birds
368		Neossology	Study of nestling birds.
369		Helminthology	Study of worms.
370		Embryology	Study of embryos.
371		Piscatology	Study of fishes
372		Entomology	Study of insects.
373		Herpetology	Study of reptiles and amphibians.
374		Ichthyology	Study of fish.
375		Insectology	Study of insects.
376		Oology	Study of eggs.

Sr. No.	Category	Field	Description
377		Zoochemistry	Study of the chemistry of animals.
378		Coleopterology	Study of beetles and weevils.
379		Myrmecology	Study of ants.
380		Pestology	Science of pests
381		Odonatology	Study of dragonflies and damselflies.
382		Orthopterology	Study of cockroaches.
383		Hippology	Study of horses.
384		Acarology	Study of mites and ticks.
385		Apiology	Study of bees.
386		Arachnology	Study of arachnids.
387		Arthropodology	Study of arthropods like insects and arachnids.
388		Astacology	Science of crayfish.
389		Batrachology	Study of frogs.
390		Carcinology	Study of crabs and other crustaceans.
391		Cetology	Study of whales and dolphins.
392		Felinology	Study of felines.
393		Mammalogy	Study of mammals.
394		Mazology	Mammalogy; study of mammals.
395		Therology	Study of wild mammals.
396		Zoogeography	Study of the geographic distribution of animals.
397		Zoosemiotics	Study of animal communication.
398		Teuthology	Study of cephalopods.
399		Zootaxy	Science of classifying animals.
400		Cynology	Scientific study of dogs.
401		Primatology	Study of primates.
402		Nematology	Study of nematodes.
403		Ophiology	Study of snakes.
404		Lepidopterology	Study of butterflies and moths.
405		Melittology	Study of bees.
406		Limacology	Study of slugs.
407		Malacology	Study of molluscs.
408		Conchology	Study of shells.
409		Ornithology	Study of birds.
410		Entozoology	Study of parasites that live inside larger organisms.
411	Mathematics	Algebra	Study of algebraic structures and manipulation of statements.
412		Geometry	Study the sizes, shapes, positions, angles and dimensions of things.
413		Mathematics	Study of magnitude, number, and forms.
414		Topology	Study of places and their natural features.
415		Cryptology	Study of codes.
416		Chaology	Study of chaos or chaos theory.
417	Medical Sciences	Actinobiology	Synonymous with radiobiology.
418		Cell biology	Study of the different structures and functions of both eukaryote and prokaryote cells.

Sr. No.	Category	Field	Description
419		Chronobiology	Study of biological rhythms.
420		Stoichiology	Science of elements of animal tissues.
421		Radiobiology	Study of the scientific principles, mechanisms, and effects of the interaction of ionizing radiation with living matter.
422		Microanatomy	Study of microscopic tissues.
423		Myology	Study of muscles.
424		Organology (biology)	Study of form, structure, development, and functions of plant or animal organs.
425		Coprology	Study of feces.
426		Cytology	Study of living cells.
427		Histology	Study of the tissues of organisms.
428		Physiology	Study of processes of life.
429		Morphometrics	Study of size and shape.
430		Biomechanics	Study of the structure, function, and motion of the mechanical aspects of biological systems.
431		Biotribology	Study of friction, wear, and lubrication of biological systems.
432		Periodontics	Study of gums.
433		Threpsology	Science of nutrition.
434		Trophology	Study of nutrition.
435		Sitology	Dietetics, the study of diet and nutrition.
436		Dietetics	Study of prevention of health conditions and diseases through human nutrition and regulation of diet.
437		Quinology	Study of quinine.
438		Meconology	Study of or treatise concerning opium.
439		Dosiology	Study of doses (usually in pharmacology).
440		Pharmacognosy	Study of drugs of animal and plant origin.
441		Pharmacology	Study of drugs.
442		Posology	Science of quantity or dosage.
443		Zootechnics	Science of breeding animals.
444		Hippiatrics	Study of diseases of horses.
445		Theriogenology	Study of animals' reproductive systems.
446		Zoonosology	Study of animal diseases.
447		Zoopathology	Study of animal diseases.
448	Medicine and Health	Endemiology	Study of local diseases.
449		Aceology	Science of remedies, or of therapeutics; iamatology.
450		Acology	Study of medical remedies.
451		Adenology	Study of glands.
452		Algedonics	Science of pleasure and pain.
453		Allergology	Study of causes and treatment of allergies.
454		Anaesthesiology	Study of anaesthetics.
455		Anatomy	Study of the structure of the body.
456		Andrology	Study of men's physiology.
457		Angiology	Study of blood flow and lymphatic system.
458		Arthrology	Study of joints.

Sr. No.	*Category*	*Field*	*Description*
459		Astheniology	Study of diseases of weakening and aging.
460		Audiology	Study of hearing.
461		Balneology	Science of the therapeutic use of baths.
462		Aedoeology	Science of generative organs.
463		Algology (Medicine)	Study of pain.
464		Cardiology	Study of the heart.
465		Chiropody	Medical science of feet.
466		Dermatology	Study of skin.
467		Iatrology	Treatise or text on medical topics; study of medicine.
468		Medicine	Science of diagnosis, prognosis, treatment, and prevention of disease.
469		Rheumatology	Study of rheumatism and related diseases affecting joints and connective tissues.
470		Sarcology	Study of fleshy parts of the body.
471		Teratology	Study of birth defects and later abnormalities in living organisms.
472		Toxicology	Study of poisons.
473		Stomatology	Study of the mouth.
474		Trichology	Study of hair and its disorders.
475		Symptomatology	Study of symptoms of illness.
476		Urology	Study of urine and the urinary tract.
477		Venereology	Study of venereal diseases.
478		Radiology	Study of X-rays and their medical applications.
479		Syphilology	Study of syphilis.
480		Tocology	Obstetrics; midwifery.
481		Tokology	Study of childbirth.
482		Rhinology	Study of the nose, particularly related to medical conditions.
483		Sphygmology	Study of the pulse.
484		Typhlology	Study of blindness and the blind.
485		Traumatology	Study of wounds and their effects.
486		Veterinary medicine	Study of medicine in domesticated animals.
487		Hydropathy	Study of treating diseases with water.
488		Iridology	Study of the iris; diagnosis of disease based on the iris of the eye.
489		Desmology	Study of ligaments.
490		Osteology	Study of bones.
491		Odontology	Study of teeth.
492		Leprology	Study of leprosy.
493		Malariology	Study of malaria.
494		Otorhinolaryngology	Study of ear, nose, and throat.
495		Laryngology	Study of the larynx.
496		Loimology	Study of plagues and epidemics.
497		Ophthalmology	Study of eye diseases.
498		Helcology	Study of ulcers.
499		Hepatology	Study of liver, gallbladder, biliary tree, and pancreas.

Sr. No.	Category	Field	Description
500		Nostology	Study of senility.
501		Gastroenterology	Study of the digestive system.
502		Gerocomy	Study of old age.
503		Gynaecology	Study of women's physiology.
504		Mastology	Study of breasts; especially in the context of health and diseases.
505		Nosology	Study of diseases.
506		Clinology	Study of aging or individual decline after maturity.
507		Iatromathematics	Archaic practice of medicine in conjunction with astrology.
508		Immunology	Study of immunity.
509		Immunopathology	Study of immunity to disease.
510		Nephrology	Study of the kidneys.
511		Epileptology	Study of epilepsy.
512		Neurology	Study of the nervous system.
513		Obstetrics	Study of midwifery.
514		Oncology	Study of tumors.
515		Optology	Study of sight.
516		Optometry	Science of examining the eyes.
517		Otology	Study of the ear.
518		Pharyngology	Study of the throat.
519		Phoniatrics	Study and correction of speech defects
520		Parasitology	Study of parasites.
521		Nasology	Parody nose classification.
522		Etiology	Science of causes, especially of disease.
523		Histopathology	Study of changes in tissue due to disease.
524		Pathology	Study of disease.
525		Pyretology	Study of fevers.
526		Ephebiatrics	Branch of medicine dealing with adolescence.
527		Neonatology	Study of newborn babies.
528		Paedology	Study of children.
529		Paidonosology	Study of children's diseases; paediatrics.
530		Iamatology	Study of remedies.
531		Emetology	Study of vomiting.
532		Emmenology	Study of menstruation.
533		Endocrinology	Study of glands.
534		Haemataulics	Study of movement of blood through blood vessels.
535		Hematology	Study of blood.
536		Hemodynamics	Study of the dynamics behind blood circulation.
537		Kinesiology	Study of human movement and posture.
538		Podiatry	Study and treatment of disorders of the foot; chiropody.
539		Podology	Study of the feet.
540		Proctology	Study of rectum, anus, and colon.
541		Psychopathology	Study of mental illness.
542		Chirology	Study of the hands.

Sr. No.	*Category*	*Field*	*Description*
543		Hygiastics	Science of health and hygiene.
544		Pneumonology	Study of diseases involving the respiratory tract.
545		Gerontology	Study of the elderly and aging.
546		Reflexology	Study of reflexes.
547		Splanchnology	Study of the entrails or viscera.
548	Natural Sciences	Catacoustics	Science of echoes or reflected sounds.
549		Craniology	Study of the skull.
550		Physics	Study of properties of matter, force and energy.
551		Aromachology	Study of smell and odour.
552		Microscopy	Study of minute objects using a microscope.
553	Physical Sciences	Aerolithology	Study of aerolites; meteorites.
554		Astrogeology	Study of extraterrestrial geology.
555		Horology	Science of time measurement.
556		Palaeoclimatology	Study of ancient climates.
557		Glaciology	Study of ice ages and glaciation.
558		Hydrology	Study of water resources.
559		Hydrogeology	Study of ground water.
560		Palaeolimnology	Study of ancient lakes
561		Paleoseismology	Study of earthquakes that happened in the past.
562		Palaeopedology	Study of early soils.
563		Pedology	Study of soils.
564		Potamology	Study of rivers.
565		Snow hydrology	Study of snow.
566		Geotechnics	Study of increasing habitability of the Earth.
567		Hydraulics	Study of application of engineering, chemistry and other fields of science involving the use of liquids.
568		Pneumatics	Study of mechanics of gases
569		Biophysics	Study of physics of biological phenomena.
570		Chemistry	Study of properties and behaviors of substances.
571		Stereochemistry	Study of chemistry of the relative spatial arrangement of atoms that form the structure of molecules and their manipulation.
572		Supramolecular chemistry	Study of the chemistry of assembled molecular sub-units.
573		Radiochemistry	Study of ordinary chemical reactions under radioactive circumstances.
574		Electrochemistry	Study of relations between electricity and chemicals.
575		Acoustics	Science of sound.
576		Aerodynamics	Dynamics of gases; science of movement in a flow of air or gas.
577		Aerostatics	Science of air pressure; art of ballooning.
578		Astrodynamics	Study of motion of rockets and spacecraft.
579		Astrophysics	Study of behaviour of interstellar matter.
580		Ballistics	Study of the motion of projectiles.
581		Barology	Study of gravitational force.
582		Calorifics	Study of heat.

Sr. No.	*Category*	*Field*	*Description*
583		Classical mechanics	Study of motion of macroscopic objects.
584		Electrology	Study of electricity.
585		Electromagnetism	Study of electromagnetic force.
586		Kinematics	Study of motion.
587		Kinetics	Study of forces producing or changing motion.
588		Kymatology	Study of wave motion.
589		Magnetics	Study of magnetism.
590		Magnetostatics	Study of magnetic fields in systems where the currents are steady.
591		Mechanics	Study of action of force on bodies.
592		Photonics	Study of photons.
593		Quantum mechanics	A fundamental theory in physics which describes nature at the smallest scales of energy levels of atoms and subatomic particles.
594		Quantum physics	The study of matter and energy at the most fundamental level.
595		Spectroscopy	Study of spectra.
596		Rheology	Science of the deformation or flow of matter.
597		Statics	Study of bodies and forces in equilibrium.
598		Thermodynamics	Study of relation of heat to motion.
599		Thermology	Study of heat.
600		Thermokinematics	Study of motion of heat.
601		Chromatics	Study of color.
602		Electrodynamics	Study of the effects arising from the interactions of electric currents with magnets, with other currents, or with themselves.
603		Electrostatics	Study of static electricity.
604		Contact mechanics	Study of the deformation of solids that touch each other.
605		Dynamics	Study of forces and their effects on motion.
606		Energetics	Study of energy under transformation within various fields.
607		Fluid dynamics	Study of flow of fluids.
608		Fluid mechanics	Study of fluids behavior at rest and in motion.
609		Fluid statics	Study of fluids behavior at rest.
610		Gyrostatics	Study of rotating bodies.
611		Hydrodynamics	Study of movement in liquids.
612		Hydrokinetics	Study of motion of fluids.
613		Hydrostatics	Study of fluids behavior at rest.
614		Hygroscopy	Study of humidity.
615		Hygrometry	Science of humidity.
616		Magnetohydrodynamics	Study of electrically conducting fluids.
617		Harmonics	Study of musical acoustics.
618		Dioptrics	Study of light refraction.
619		Optics	Study of light.
620		Pseudoptics	Study of optical illusions
621		Metrology	Science of weights and measures.
622		Exobiology	Study of extraterrestrial life.
623		Areology	Study of Mars.

Sr. No.	*Category*	*Field*	*Description*
624		Asteroseismology	Study of star oscillations.
625		Astrobiology	Study of extraterrestrial life.
626		Astronomy	Study of celestial bodies and phenomena.
627		Cometology	Study of comets.
628		Heliology	Science of the Sun.
629		Stellar astronomy	Study of stars, their origins, and their evolution.
630		Uranology	Study of the heavens; astronomy.
631		Uranography	Descriptive astronomy and mapping.
632		Selenology	Study of the Moon.
633		Zenography	Study of the planet Jupiter.
634		Meteoritics	Study of meteors.
635		Celestial mechanics	Study of motion of objects in outer space.
636		Cosmology	Study of the universe.
637		Helioseismology	Study of Sun’s interior by observing its surface oscillations.
638		Exoplanetology	Study of exoplanets.
639		Hermeology	Study of Mercury.
640		Necroplanetology	Study of the destruction of planets.
641		Planetology	Study of planets
642		Astrobotany	Study of plants in space.
643		Cosmochemistry	Study of the chemical composition of matter in the universe and the processes that led to those compositions.
644		Astronautics	Study of navigation beyond Earth’s atmosphere.
645	Pseudosciences	Spectrology	Study of ghosts.
646		Numerology	Pseudoscientific study of numbers.
647		Phrenology	Study of bumps on the head
648		Parapsychology	Study of unexplained mental phenomena
649		Cryptozoology	Study of animals for whose existence there is no conclusive proof.
650		Scatology	Study of excrement or obscene literature.
651		Satanology	Study of the devil.
652	Social Sciences	Hoplology	Study of human combative behavior and performance.
653		Sinology	Study of China.
654		Neuroeconomics	Study of human decision making and the ability to process multiple alternatives and choose an optimal course of action.
655		Sociobiology	Study of the biological basis of human behaviour.
656		Olfactology	Study of the sense of smell.
657		Ethology	Study of natural or biological character.
658		Kinesics	Study of gestural communication.
659		Ktenology	Science of putting people to death.
660		Penology	Study of crime and punishment
661		Victimology	Study of victims, particularly those of crime.
662		Larithmics	Study of population statistics.
663		Cambistry	Science of international exchange.
664		Catallactics	Science of commercial exchange.

Sr. No.	*Category*	*Field*	*Description*
665		Chrematistics	Study of wealth; political economy.
666		Macroeconomics	Branch of economics dealing with the performance, structure, behavior, and decision-making of the whole economy.
667		Microeconomics	Branch of economics that studies the behavior of individual households and firms in making decisions on the allocation of limited resources.
668		Socioeconomics	Study of the relationship between economy and society.
669		Finance	Science or study of money management.
670		Plutology	Political economy; study of wealth.
671		Economics	Study of material wealth (production, distribution, and consumption of goods and services).
672		Andragogy	Theory and practice of education of adults.
673		Catechectics	Art of teaching by question and answer.
674		Pedagogics	Study of teaching.
675		Eidology	Study of mental imagery.
676		Idiopsychology	Study of the psychology of one's own mind.
677		Metapsychology	Study of the nature of the mind.
678		Neurypnology	Study of hypnotism.
679		Oneirology	Study of dreams.
680		Psychognosy	Study of mentality, personality or character.
681		Suicidology	Study of suicide.
682		Psychogenetics	Study of internal or mental states.
683		Psycholinguistics	Study of relationship between psychology and language.
684		Hypnology	Study of sleep; study of hypnosis.
685		Characterology	Study of development of character.
686		Psychology	Study of mind.
687		Agriology	Comparative study of primitive peoples.
688		Storiology	Study of folk tales.
689		Raciology	Study of racial differences.
690		Tsiganology	Study of gypsies.
691		Thanatology	Study of death and its customs.
692		Typology	Study of types of things.
693		Ethnobiology	Study of dynamic relationships between peoples.
694		Ethnobotany	Study of a region's plants and their practical uses through the traditional knowledge of a local culture and people.
695		Palaeoanthropology	Study of early humans.
696		Cacogenics	Study of racial degeneration.
697		Ethnogeny	Study of origins of races or ethnic groups.
698		Ethnology	Study of cultures.
699		Archology	Science of the origins of government.
700		Metapolitics	Study of politics in theory or abstract.
701		Psephology	Study of election results and voting trends.
702		Stasiology	Study of political parties.
703		Polemology	Study of war.

Sr. No.	*Category*	*Field*	*Description*
704		Diplomatology	Study of diplomats.
705		Graphology	Study of handwriting.
706		Ergology	Study of effects of work on humans.
707		Pseudology	Art or science of lying.
708		Euthenics	Science concerned with improving living conditions.
709		Home Economics	Deals with home and economics.
710		Oikology	Science of housekeeping.
711		Praxeology	Study of practical or efficient activity; science of efficient action
712		Political science	Study of politics.
713		Anthropology	Study of human cultures.
714		Queer theory	Study of issues related to sexual orientation and gender identity.
715		Sociology	Study of society.
716		Criminology	Study of crime and criminals.
717		Demography	Study of population.
718		Ekistics	Study of human settlement.
719		Demology	Study of human behavior.
720		Ethnomethodology	Study of everyday communication and social interaction.
721		Parthenology	Study of virgins.
722	Technology	Automata Theory	Study of abstract machines and computational problems.
723		Computer science	Study of processes that interact with data.
724		Scientific programming	Study of programming.
725		Theoretical computer science	Science combining computer science and mathematics.
726		Quantum computing	The exploitation of collective properties of quantum states, such as superposition and entanglement, to perform computation.
727		Serology	Study of serums.
728		Information science	Study of distribution of information.
729		Library and Information Science	Study of organization, access, collection, and protection/regulation of information, whether in physical or digital forms.
730		Dactyliology	Study of rings.
731		Archival Science	Study of building and curating archives.
732		Bibliology	Study of books.
733		Bibliotics	Study of documents to determine authenticity.
734		Library Science	Study of the collection of information.
735		Systems science	Study of systems.
736		Cybernetics	Study of circular causal processes (such as feedbacks).
737		Information technology (IT)	Study of telecommunication and the use of computers.

It is evident from Table 1 that significant efforts have been made on aspects related to life sciences, with a strong focus on biology, zoology, medicine, and related fields.

The above-mentioned narrative may seem to be exhaustive in the context of science. However, the truth is that we have far too much to fathom and appreciate when it comes to nuances of each branch of science. The above-mentioned list shows different branches of science and humanities, totaling about 737 disciplines. There are several branches that are similar looking but are still different. Words with similar meaning are given hereunder as an example.

Semantics means study of meaning, whereas Semantology means science of meanings of the words. Similarly, Semasiology means study of meaning which is semantics. When we see Semiology that means study of signs and *signals* but Semiotics means study of signs and *symbols*. There is not much difference because these terminologies all belong to same categories enhancing the richness of subjects and language both simultaneously.

Many students may not be aware of these details and therefore it is envisaged that this publication will evoke their imagination to become aware of these subjects. Our current aim is to discuss the serendipity in the context of science and success. Therefore, we have opted to discuss limited examples of *serendipity*. That means a number such instances are going to be left out. Notwithstanding these brief discussions, we assume that this would provide fuel for thoughts for someone to mount similar attempts to highlight importance of other branches of science and humanity in their full glory.

II. Serendipity

The Oxford English Dictionary defines serendipity as "the faculty of making happy and unexpected discoveries by accident." Serendipity is an unplanned and fortunate discovery that is a common occurrence in scientific world for product invention. It's a critical mechanism in scientific inquiry that can foster incremental advancements by combining existing ideas and observations. There are several glaring examples that explain the nuance of serendipity. However, it may be noted that serendipity cannot happen unless the person has been working in that area with deep involvement. That means, one has to create a fertile ground for serendipity to crop up. At the same time, the person has to have an alert mind. *There is a voiceless subtle communication between serendipity and the person involved*. Herewith, we provide some example related to serendipities with their far reaching implications and large scale applications [2-3].

III. Microwaves Oven

Percy Spencer, an American engineer employed by Raytheon, made the discovery of the heating effect of a high-power microwave beam in 1945. While he was developing a magnetron that could emit powerful radiation beams, he discovered that a chocolate bar in his pocket had melted. Curious, he put a bowl of popcorn in front of the tube, and it started to pop. By directing microwave energy from a magnetron into a metal container from which it was unable to leave, Spencer subsequently produced a high-density electromagnetic field. The food's temperature rapidly increased when it was put in the box. Raytheon patented the invention in October of that year, and in 1947 it was made publicly available. Thus, within two years of discovery, it reached from laboratory to homes in the form of microwave oven for it domestic use. Percy Spencer was the first person to think of using the heat generated by microwaves to cook food. He received a patent for his idea in 1950. For his work, he received the Distinguished Public Service Award by the US Navy. Today, we use microwave as an integral part of our kitchen and in several other establishments. Although all of us are familiar with the commercial microwave oven, but a picture (Fig. 1) is shown here for the record sake.

Fig. 1: Microwave Oven

IV. Drug Discovery

Meprobamate, imipramine, aniline purple, lysergic acid diethylamide, and chlorpromazine were all discovered by serendipity. Scientific breakthroughs take ages of hard work and research but once in a while, serendipity provides clues and the results is obtained with the final push. Some examples are given hereunder.

V. Discovery of Penicillin

Alexander Fleming's discovery of penicillin is an example of serendipity. After its discovery, this became lifesaving drug for a large number of patients. Penicillin, arguably the most well-known accidental discovery ever, is one of several antibiotics used to treat bacterial infections. The Scottish biologist Alexander Fleming took a vacation in 1928 from his staphylococci research in the lab. He discovered a blue-green mold growing in one Petri dish that had been left open when he returned. The culture's surrounding microorganisms had all been eliminated by this fungus (Fig. 2). The mold carried the potent antibiotic penicillin, which could eradicate dangerous bacteria without endangering human health. Fleming's conclusions were not widely accepted by scientists at the time. Actually, it took ten more years for this medication to be approved for use in humans. When modern medicine first emerged, Fleming's accidental discovery was given credit. Thus, penicillin appeared on the scene that became an important antibiotic dubbed the 'wonder drug'. This helped hospitals combat what used to be the leading causes of death. This covers a wide range of illnesses brought on by harmful bacteria, such as rheumatic fever, tonsillitis, strep throat, scarlet fever, diphtheria, syphilis, gonorrhea, meningitis, pneumonia, and sepsis.

Fig. 2

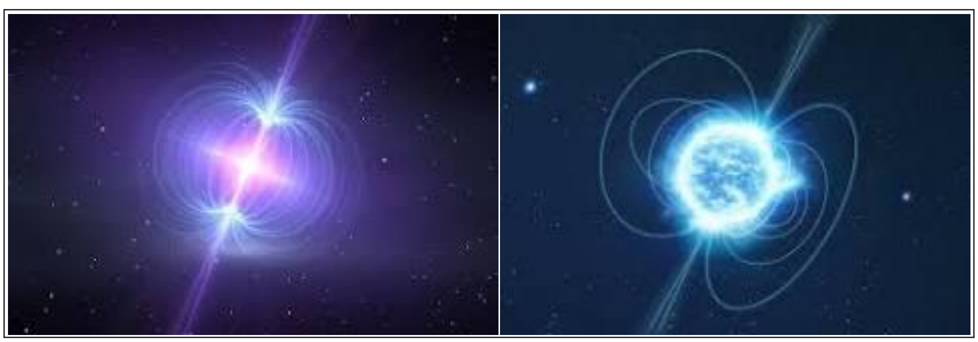
Fig. 2 shows the origin of penicillin showing fungal growth all over petri dish responsible for killing all the bacteria owing to production of a strong antibiotic (Image Credit: Kallayanee Naloka/Shutterstock.com).

The discovery of Penicillin turned out to be a driving force to search for other antibiotics from across the spectrum of the microbes. Approximately 500 new families of low-molecular-weight compounds are published annually, and as of right now, over 10,000 antibiotics and related bioactive metabolites have been identified from bacteria. The cost of creating an antibiotic is estimated to be over US$1.5 billion in 2017. According to industry estimates, the average annual revenue from the sale of antibiotics is approximately US$46 million.

VI. Pulsars

Jocelyn Bell, a PhD student studying astronomy, observed an odd "bit of scruff" emanating from her radio telescope in 1967. It was a typical signal of a kind that no known natural sources would generate, and it came from the same area of the sky. Bell and her supervisor, Anthony Hewish, eliminated satellites, television transmissions, and other researchers as potential human interference sources. There was no explanation for the signal, and the experts questioned whether they had picked up an alien sign. The discovery of another one in a different area of the sky disproved this theory because it didn't seem likely that two groups of aliens would be attempting to contact Earth at the same time.

It was, in fact, the first finding of a pulsar, or pulsating radio star, which is a rotating neutron star that is highly magnetized and produces electromagnetic radiation. The presence of gravitational radiation is indirectly confirmed by pulsars, which were predicted thirty years ago but had never been observed. A and B in Fig. 3 depict the Pulsar image [4].



(A) (B)

Fig. 3

Fig. 3 (A and B) shows the majority of positively charged protons and negatively charged electrons inside neutron stars combine to form uncharged neutrons due to the strong gravity in their cores, which is how these stars received their name. There is no new heat produced by neutron stars, but when they form, they are extremely hot and cool slowly.

VII. Radioactivity

Radiation is a form of energy that can be emitted as rays, particles, or electromagnetic waves but not visible to the human eyes. Some types of radiation, like visible light and infrared radiation, can be seen or felt, but others, like x-rays and gamma rays, are not visible and can only be detected with special equipment. For example, cloud chambers are Nobel Prize winning devices that can make invisible radiation visible. Portal monitors are detection systems that can monitor people, vehicles, and cargo for radioactive contamination.

Phosphorescent materials, known for glowing in the dark after exposure to light, were the focus of French scientist Henri Becquerel's research. In 1896, while working with uranium-enriched crystals, he hypothesized that sunlight would cause the crystal to leave an impression on a photographic plate. However, due to bad weather, he stored the crystal in a dark drawer, postponing his experiments. When he returned to the crystal days later, he discovered the photographic plate had become "fogged," indicating the crystal emitted radiation even without sunlight. This accidental discovery revealed the presence of an invisible type of radiation capable of penetrating materials like paper and exposing the plate.

Pierre and Marie Curie carried on this investigation and gave the phenomenon the name "radioactivity." The risks posed by radiation were not fully recognized in the initial years following the discovery. Today, its use is more closely monitored, and it has a range of applications in industry, defence, medicine, transportation, travel, finance and forensic sciences. There are standard units for radiation measurements. For example, one Becquerel (Bq) is equal to one radioactive decay per second. The Becquerel is the International System of Units (SI) unit of radioactivity. Here are some other radiation units.

Curie (Ci): One curie is equal to about 3.7 x 1010 decays per second, which is the approximate number of radioactive decays in one gram of radium per second.

Millicurie (mCi): One millicurie is equal to 37 megabecquerels (MBq). The Becquerel is named after Henri Becquerel, who shared the 1903 Nobel Prize in Physics with Pierre and Marie Curie for their work in discovering radioactivity. A large number of radioactive substances are found in nature giving rise to background radiation. Terrestrial radiation contains certain radioactive isotopes. For instance, the rocks and soil naturally contain radioactive isotopes of uranium, thorium, and radium. Water also contains trace levels of uranium and thorium. The air contains radon, which is produced when radium decays radioactively. Therefore, there are a variety of radiation sources, and it is within the purview of study and invention to harness this energy for human benefit.

VIII. Vulcanised Rubber

In the 1830s, the United States experienced a surge in demand for rubber products, leading to the establishment of numerous factories to produce items from this waterproof material. However, the enthusiasm was short-lived, as rubber proved unreliable—it became rigid in cold weather and sticky in heat. The turning point came with the accidental discovery of vulcanization, a process involving the chemical cross-linking of rubber molecules with organic or inorganic agents under heat and pressure. The result, known as vulcanized rubber (Fig. 4), is more durable and stable, finding widespread application across various industries.

Fig. 4: Example of Vulcanized Rubber for its Industrial Use

The story of vulcanization began with Charles Goodyear, a self-taught chemist who struggled to make rubber more durable. In 1839, he accidentally dropped a rubber mixture onto a hot stove, creating a weather-resistant, elastic material through chemical cross-linking. Though Goodyear recognized the significance of his discovery, he died in debt, unable to benefit from it. Today, vulcanized rubber remains essential, especially in car tires, and his legacy endures through the Goodyear name.

IX. X-Rays

Wilhelm Roentgen, a German physicist, was experimenting with a cathode ray tube in 1895. Even though the tube was covered, while the tube was on and the room was dark, a fluorescent screen close by would continue to glow. The screen was illuminated by the rays. Roentgen attempted to stop the rays, but the majority of the objects he put in front of them had no effect. He was able to see his bones in the image that was displayed on the screen, though, when he put his palm in front of the tube (Fig. 5). The first x-ray image was created 129 years ago when a photographic plate was used in place of the tube.

Fig. 5: X-Ray Image of the Hand Showing All the Joints and Bones

Fig. 5 shows X-ray picture of a hand showing its image with all the joints. This approach is commonly used by orthopaedic surgeons' world over to assess the broken bones and fix them accordingly. Besides, bone, X–ray is also used for other parts of the human and animal bodies.

X. Atomic Nucleus

In 1911, Ernest Rutherford, a physics professor at Manchester University renowned for his radiation studies, oversaw a groundbreaking experiment conducted by German physicist Hans Geiger and undergraduate student Ernest Marsden. They investigated how alpha particles scattered when directed at a thin sheet of gold foil. Rutherford, known for his attention to detail, suggested Marsden examine whether any particles deflected backward. To their surprise, some particles did scatter backward instead of passing straight through with minimal deviation—a completely unexpected outcome. Rutherford concluded that the unexpected scattering was due to a dense, positively charged core at the center of the atom—the nucleus—where most of the atom's mass is concentrated (Fig. 6). Although the team had not been specifically searching for the atom's structure, this discovery became one of the most significant breakthroughs in modern physics and chemistry.

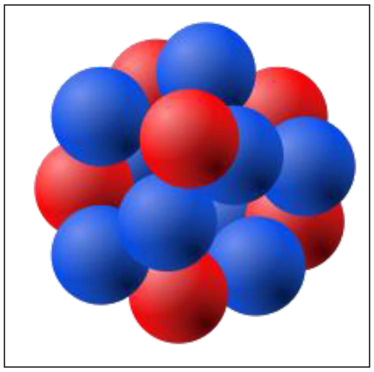


Fig. 6

Fig. 6 shows the atomic nucleus is the small, dense region consisting of protons and neutrons at the center of an atom, discovered in 1911 by Ernest Rutherford based on the 1909 Geiger–Marsden gold foil experiment (Credit: https://en.wikipedia.org/wiki/Nucleon).

XI. Smart Dust

In 2003, Jamie Link, a graduate student in chemistry, was working on a silicon chip at the University of California, San Diego. Although the chip broke, it was not a catastrophic event. Little pieces of the chip were still sending signals, acting as small sensors, Link and her supervisor found. The particles that assembled themselves were dubbed "Smart Dust." Sensory and computational capabilities were demonstrated by these microelectromechanical systems (Fig. 7). It is being used to find and eliminate bodily tumors, identify dangerous substances in the air, and check the quality of water. It has been recognized as one of the greatest innovations of this century.

Link and her graduate adviser started recording the discovery and its applications after realizing the importance of the knowledge gathered following the disaster [5-6]. The lab in which Link was working was focused on sensors. One application of smart dust was to detect pollutants in water. Smart dust is designed to interact with water by aligning its components in response to specific substances. Upon detection, the elements rearrange to form visible patterns, such as a red design when a particular ingredient is identified. Over time, smart dust has evolved into highly advanced sensors integrated into interconnected networks, enhancing their functionality and applications [7]. The concept of smart dust involves individual sensors, known as motes, which can communicate with a gateway or other devices. Each mote is typically equipped with a small power source, such as a solar cell or battery (Fig. 7). Depending on its design and application, a mote can detect various environmental factors, including light, temperature, vibration, or magnetic fields.

Fig. 7: Smart Dust on a Human Fingertip Giving the Idea of its Relative Size

Innovative inventions are not a coincidence, as demonstrated by Jamie Link's work. The creator had the foresight to see the possible impact and modify their study accordingly, even if they might result from an unforeseen circumstance or conclusion. It would be more accurate to characterize the unintentional findings that were given here as an unanticipated consequence. Unexpected things happened while the researchers were trying to develop one item. Instead of continuing with their initial objective, they decided to pursue it after realizing they had come onto something more valuable. These findings have affected ubiquitous computing as well as miniaturization. As a result, computers are becoming more and more common and smaller.

XII. Gunpowder

Many people believed that alchemy, the prominent medieval practice of trying to turn base metals into gold, was a combination of magic and science. Alchemy is now limited to magical and fantastical stories. Alchemists' pursuit of enormous wealth and amazing healing abilities, however, led to unintentional scientific discoveries that have tremendously helped modern science. One of the most well-known unintentional discoveries is gunpowder [8]. It was discovered when Chinese alchemists searched for the elixir of perpetual life in the ninth century. The primary ingredient of gunpowder, saltpetre, was inadvertently discovered by Tang Dynasty Chinese alchemists as they were working to make a potion of immortality. Saltpetre was discovered in combination with sulfur and charcoal as a consequence of more investigations. While it was not the elixir for eternal life, the mixture had excellent flammable and explosive properties. The resulting gunpowder was initially used to create fireworks (Fig. 8). However, by 904 AD, it was being used in warfare. Gunpowder, also known as black powder, is composed of sulfur, charcoal, and potassium nitrate. Sulfur and charcoal serve as fuels, while potassium nitrate, or saltpetre, acts as an oxidizer. As a low explosive, gunpowder deflagrates instead of detonates. It is used as a propellant in firearms, artillery, and rocketry, as well as a blasting agent in mining, quarrying, and construction. The modern formulation, consisting of 75% nitrate, 15% charcoal, and 10% sulfur, was established in England during the mid-18th century. Different countries used varying formulas, which may have influenced their military successes or failures.

Fig. 8: Gunpowder and its Initial Use in Firearms and Firework

XIII. Quantum Computing

The multidisciplinary discipline of quantum computing, which combines mathematics, physics, and computer science, uses quantum mechanics to solve complicated problems more quickly than traditional computers. However, a lot of the advancements in the field of quantum computing would not have been possible without an unintentional discovery.

Engineer David Awschalom left the University of California to work at the University of Chicago after encountering difficulties with his study. There, he and his colleagues studied a substance they thought would be essential to advancing the field of quantum computing. This substance—a thin layer of atoms atop a substrate of strontium titanate—was the subject of their investigation. However, there was a lot of noise that tainted their findings. After months of investigation, the team finally identified the source of the noise as the lab's energy-efficient light bulbs.

The light from the bulbs had the precise wavelength needed to polarize strontium titanate and change its electrical characteristics. The scientists discovered that they could "paint" electrical junctions with this wavelength and then remove them with another wavelength. Scientists are currently using this technique to build quantum computers by using wavelengths to generate electrical circuits. As a result, quantum computers differ greatly from classical computers and have a wide range of uses.

Fig. 9: A Quantum Computing Image Highlighting Futuristic Microchip Processor with Lights on the Blue Background

XIV. Mechanism of Quantum Computing

The nature and behavior of matter and energy at the quantum, or atomic and subatomic, levels are explained by quantum theory. Quantum computing exploits the properties of quantum matter: Quantum computing employs 1s, 0s, and both a 1 and a 0 at the same time, whereas traditional computing uses binary bits, or 1s and 0s. The ability of bits to exist in several states simultaneously gives the quantum computer a significant boost in processing capability. A conventional computer that executes a program and transmits commands, a region that contains qubits, and a mechanism that converts signals to qubits make up a quantum computer. In conventional computing, a qubit, also known as a quantum bit, is comparable to a bit. The fundamental unit of information in a quantum computer is called a qubit, which is similar to the bit in a classical computer. Electrons and photons, for example, can be charged or polarized to behave as a 0, 1, or both 0 and 1 in quantum computers. Superposition and entanglement are the two most important concepts in quantum physics. While entanglement is the direct alteration of one qubit by another, superposition is the arrangement of the quantum information a qubit contains into a state of all possible configurations.

Quantum computers are highly resource-demanding, requiring substantial energy and cooling to operate effectively. For instance, IBM uses a special coolant fluid to maintain its quantum-ready system at around 25 mK, which is nearly -459 degrees Fahrenheit. At this extremely low temperature, electrons are able to flow through superconductors, forming electron pairs. Since qubits take a superposition of 0 and 1, this means the number of computations a quantum computer could undertake is 2^n, where n is the number of qubits used. A quantum computer composed of 500 qubits has the potential to do 2^500 calculations in a single step. When entanglement and quantum superposition are combined, computing capacity is greatly increased. The increased capacity increases exponentially with the number of qubits supplied.

XV. Origin of Quantum Theory

Max Planck, a German physicist, presented the development of quantum theory to the German Physical Society in 1900. The concept that matter and energy are separate entities was first proposed by Planck. The current knowledge of quantum theory is the result of additional advancements made by a number of scientists during the next thirty years. The following are some of the components of quantum theory:

Energy, like matter, consists of discrete units -- as opposed to a continuous wave. Elementary particles of energy and matter, depending on the conditions, might behave like particles or waves. The movement of elementary particles is inherently random and, thus, unpredictable.

It is problematic to measure two complementary variables at the same time, such a particle's position and momentum. The more accurately one value is measured, the more inaccurately the other value is measured. Other quantum-enabled technologies may also become feasible because quantum technologies are still in their infancy. We do not cover those aspects because our purpose is to highlight serendipity and quantum computing. However, it may be noted that Quantum computers offer speed, ability to solve complex problems, simulation, optimization, assisting ML and AI by improving complex, high-dimensional data, processing large data sets, and improving optimization as well as feature extraction and data representation features. Similarly, Quantum computers can be used to improve research and development, supply-chain optimization and production processes. Quantum cryptography uses the principles of quantum mechanics to secure communication systems.

XVI. DNA Fingerprinting

In September 19, 1984, Sir Alec John Jeffreys from the University of Leicester, Midland, England was busy developing his X-ray film related to his work on Myoglobin gene. In a faint autoradiogram, he noticed something which otherwise would have been missed by many of us. Jeffreys, an English geneticist, discovered DNA fingerprinting almost by accident while developing a technique to detect mini-satellites in DNA. The technique involved DNA digestion with restriction enzymes to make smaller pieces and then resolving on the agarose gel using an electrical field. When once digested DNA is fully resolved, these are then transferred onto the nylon membrane. This membrane is subjected to hybridization followed by its washing and exposure to X-ray film. The hybridization is done using radioactively labelled mini-satellite DNA which picks up only the fragment that has complementary sequence on the membrane. *Jeffreys described his first reaction to the X-ray film as "God, what a mess"* Apart from identical twins, everybody's DNA has a similar characteristic pattern. Certain regions of DNA are particularly variable. When these variable patterns are statistically proven to be unique, that makes the basis of DNA fingerprint (Fig. 10). Ever since its discovery, it has been used extensively in Biology, Medicine and Forensic Sciences.

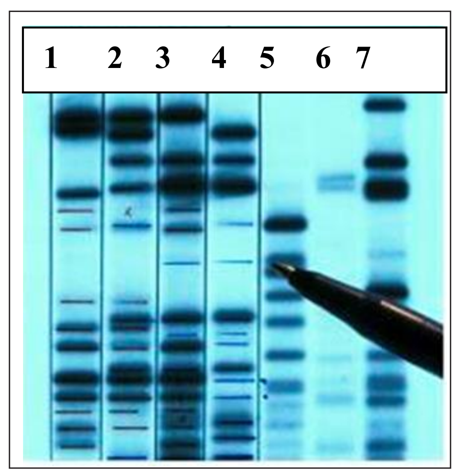


Fig. 10: DNA Fingerprinting has become an Invaluable Tool for Police to Identify Criminals from Blood, Skin, or Saliva Left at Crime Scenes

Today, DNA fingerprinting is widely used for the assessment of cell contamination, characterization of stem cell specificity, monitoring success of bone marrow transplantation, resolving paternity disputes, identification of relatives from the dead bodies or accidental victims, progeny testing, population studies, genome individualization, linkage analysis, phylogeny, evolution of species and fine tuning the studies of mutational loads within and across the species. Availability of better probes, machines and automation have uplifted this technology several folds. Here we have discussed DNAFP only in the context of serendipity.

XVII. Dmitri Ivanovich Mendeleev Table or Periodic Table

Following the rejection of Newlands Octave Law, the Mendeleev Periodic Table was introduced in 1869. Mendeleev's periodic chart organised elements according to their fundamental property, atomic mass, and chemical properties. Dmitri Ivanovich Mendeleev, a Russian scientist, was the most important contributor to the early development of the periodic table. At the time of Mendeleev, only 63 elements were known. After studying the properties of elements, Mendeleev determined that they were related to atomic mass in a periodic pattern. He arranged the elements in the periodic table so that those with similar qualities were grouped together in the same vertical columns. Mendeleev devised a row of elements arranged in ascending atomic weight order. As soon as the qualities of the components were discovered to be duplicated, he stopped that row and began a new one below it. The element displaying the repeat of the properties was placed in the first slot of this new template. Mendeleev's law states that "the Physical and Chemical Properties of the Elements are Periodic Functions of Their Atomic Weights."Mendeleev originally arranged elements in ascending order of atomic weight, one beneath the other. Elements with similar properties are grouped together. Elements with equal properties can be found in the same horizontal row. Mendeleev's first periodic table, published in 1869, is shown below (Fig. 11).

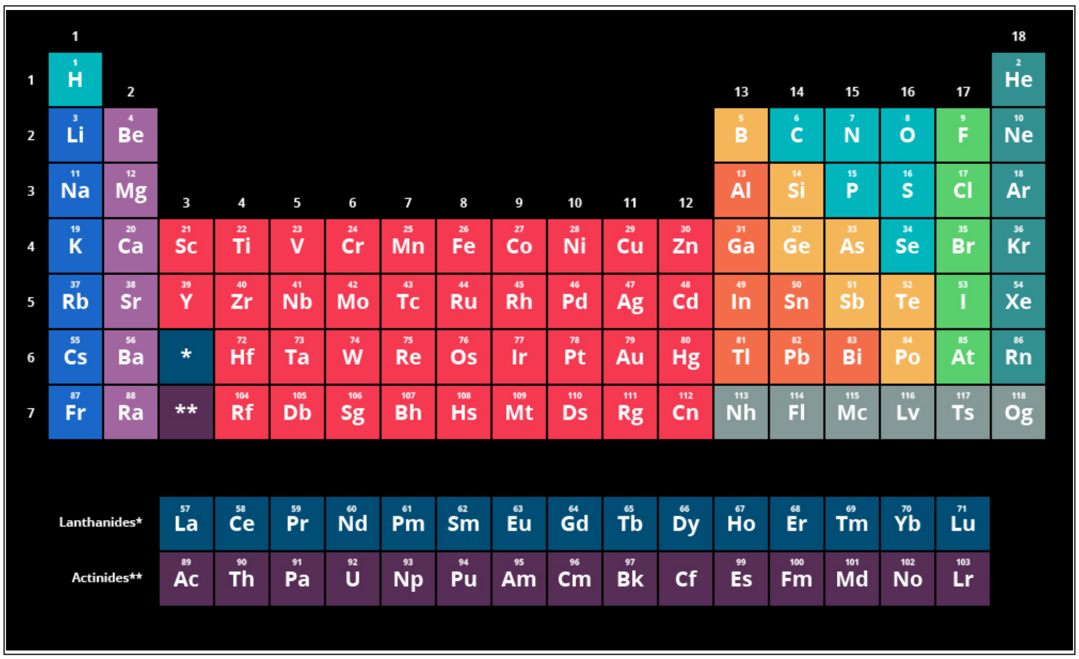


Fig. 11: Mendeleev Table Showing Positional Arrangement of All the Elements

It is said that Mendeleev saw the table in dream wherein all the elements were placed in correct and proper perspective. Though some people do not accept this and deny this dreamy business. Mendeleev himself has mentioned in his diary the following.

"I saw in a dream a table where all the elements fell into place as required. Awakening, I immediately wrote it down on a piece of paper".

Dmitri Ivanovich Mendeleev
February 17, 1869

Mendeleev discovered that the properties of elements were related to atomic mass in a periodic manner after researching the attributes of each element. He organised the elements in the periodic table so that those with comparable properties fell into the same vertical columns.

XVIII. Historical Perspective of Serendipity

When we look at the historical Perspective of Science in the context of Serendipity and Success, we find that it has a rich history that originates from literature, philosophy, along with science. The term *serendipity* was coined by British author and politician Horace Walpole in 1754, in a letter to his friend Horace Mann. Walpole explained that he derived the word from a Persian fairy tale called "The Three Princes of Serendip," where the protagonists "were always making discoveries, by accidents and sagacity, of things they were not in quest of." In this context, "Serendip" was an ancient name for Sri Lanka.

While Walpole's coining of the term is a modern occurrence, serendipitous discoveries have been part of human history for millennia. Ancient and medieval scientists, inventors, and explorers often stumbled upon findings that had far-reaching effects. We have discussed the discovery of Penicillin in 1928, by Scottish bacteriologist Alexander Fleming by accident from mold Penicillium notatum. When Christopher Columbus set sail in 1492, he intended to find a westward route to Asia but instead stumbled upon the Americas. This was one of the most historically impactful examples of serendipity, changing the course of world history. The discovery of X–ray (1895), Microwave oven (1945), rubber vulcanization, DNA fingerprinting and several other important discoveries have been covered. Accidental finding of Viagra falls in the same category. Viagra has saved many marriages and will continue to play important roles in a family life. The second aspect is key in distinguishing serendipity from mere luck. Philosopher Louis Pasteur echoed this sentiment with his famous quote, "*Chance favours the prepared mind*." Serendipity, thus, is not just about accidental findings but also about the mind-set and preparedness of the individual to recognize and capitalize on unexpected opportunities. The notion of serendipity became especially important in the history of science and innovation. Many significant breakthroughs, such as the ones mentioned earlier, were made by scientists who were investigating one thing but stumbled upon something very different.

The Structure of DNA in the early 1950s, by James Watson and Francis Crick is the testimony of the fact that this was discovered through a mix of methodical research and chance, including access to Rosalind Franklin's X-ray diffraction images, which they interpreted in a novel way. Similarly, in the 1970s, 3M scientist Spencer Silver was working on developing a super-strong adhesive, but instead, he created a weak adhesive that could easily be peeled off the surfaces. This "failed" product later became the basis for Post-It notes, one of the company's most successful products.

The examples cited here are by no means complete lists of serendipity. There could be many more inventions, products, procedures and preparations that have been resulted owing to serendipity but also highly focused attention. In contemporary research, serendipity continues to play a role, though its perception has evolved. With the rise of systematic research and technology, some people argue that serendipity is less important than it once was. However, many scientists still emphasize the importance of openness to unexpected findings. The rise of big data and machine learning has introduced new forms of serendipity, where patterns or correlations are discovered that were not anticipated earlier. In these contexts "serendipity" is increasingly being engineered through algorithms and data analysis, creating what some call "designed serendipity." Whether serendipity is going to shape the future of mankind or mankind is going to shape the future of serendipity is not clear. However, from its origins in a Persian tale to its role in scientific breakthroughs, it has remained a crucial factor in the advancement of knowledge. It represents the intertwining of chance and human insight, illustrating that while discovery can be accidental, it requires the sagacity and preparedness of individuals to recognize and develop unexpected outcomes.

Serendipity often refers to the occurrence of fortunate events by chance, which can be linked to the study of the mind in several ways as mentioned earlier. For instance, the concept of serendipity may influence how we perceive and interpret random events and their significance. In psychology and cognitive science, researchers explore how people recognize and make sense of these chance occurrences, and how this impacts decision-making, creativity, and learning.

Studies in the field might investigate how our cognitive biases and heuristics affect our ability to recognize serendipitous events or how our expectations and past experiences shape our interpretation of these events. Overall, understanding serendipity can shed light on how our mind processes and values seemingly random but beneficial occurrences.

Connecting science, serendipity, and success with well-being and happiness involves recognizing how unexpected discoveries and scientific advancements contribute to our understanding and enhancement of mental and emotional health. Here's how these elements interrelate.

Scientific research often leads to breakthroughs that improve our understanding of well-being. For example, discovering the role of neurotransmitters like serotonin and oxytocin has revealed how chemical imbalances and social connections affect happiness [9]. A serendipitous discovery involving serotonin occurred in the 1950s when researchers were studying the effects of the drug reserpine, originally used for hypertension. They unexpectedly observed that patients taking reserpine experienced depression and mood changes. This led to the realization that serotonin, a neurotransmitter affected by reserpine, plays a crucial role in regulating mood and emotional states. This discovery was pivotal in advancing the understanding of serotonin's role in mood disorders and contributed to the development of antidepressant medications [10]. Another serendipitous discovery in the science of happiness is the finding related to the "happiness hormone" oxytocin. Researchers initially studying the role of oxytocin in childbirth and lactation stumbled upon its impact on social bonding and emotional well-being. They found that oxytocin plays a significant role in enhancing feelings of trust, empathy, and social connection, thereby contributing to overall happiness and well-being [11-12]. This unexpected finding has since become a crucial area of research in understanding the biological underpinnings of happiness and social relationships.

Scientific studies provide evidence for effective practices that enhance well-being, such as mindfulness, exercise, and therapy, which are grounded in empirical research. Serendipitous discoveries in science—such as the role of endorphins or the placebo effect—often lead to new treatments and approaches that improve mental health and happiness. A notable example of serendipity in the science of the mind is the discovery of the placebo effect [13-14]. This phenomenon, where patients experience real improvements in their condition after receiving a treatment with no therapeutic value, was initially observed by accident. In the early 20th century, researchers and physicians began to notice that some patients seemed to improve after receiving sugar pills or inert substances. This unexpected result led to deeper investigations into how belief and expectation can significantly impact mental and physical health, which has since become a crucial aspect of psychological and medical research [15]. Chance findings can inspire novel interventions and therapies, contributing to a more nuanced understanding of well-being and enabling more personalized approaches to mental health. Success in various areas of life, whether personal, professional, or academic, often correlates with enhanced well-being. The sense of accomplishment and fulfilment that comes from achieving goals can enhance happiness. Success also involves managing stress and maintaining a healthy work-life balance. Scientific insights into stress management and resilience contribute to overall well-being.

Applying scientific insights about well-being and happiness, whether they arise from serendipity or planned research, can lead to practical strategies for improving mental health and quality of life. The discovery of endorphins as natural painkillers, which was initially unrelated to happiness research, revealed their role in mood regulation and pleasure, connecting biological processes with emotional well-being. A serendipitous discovery related to the biology of happiness involves the finding of the role of endorphins. In the 1970s, researchers were studying how morphine and related drugs work when they unexpectedly discovered that the brain produces its own natural painkillers, which they named endorphins. This discovery led to the realization that endorphins not only modulate pain but also play a crucial role in mood regulation and feelings of pleasure, contributing to our understanding of the biological basis of happiness. Similarly, the unexpected finding of oxytocin's impact on social bonding and trust highlighted its importance in emotional health and happiness, broadening our understanding of the neurochemical basis of positive social interactions.

These discoveries underscore how chance observations can lead to profound insights into the mind and happiness. This also shows how serendipity can drive progress in scientific understanding and applications related to mental health and emotional well-being. In essence, the interplay of science, serendipity, and success provides a dynamic framework for exploring and advancing our understanding of well-being and happiness, leading to more effective strategies for enhancing mental and emotional health.

XIX. Recent Developments

Advances in neuroscience and neuropsychology have continued to reveal how unexpected findings, such as the impact of brain regions like the prefrontal cortex and neurotransmitters, contribute to our understanding of happiness and mental well-being.

In order to succeed in life, history shows there is no shortcut. Instead one has to consistently evaluate both the positive impacts and limitations. Serendipitous findings can lead to research directions that may not be fully understood or validated, potentially diverting attention from more systematic and evidence-based approaches. Also there's a risk of overemphasizing the role of chance discoveries at the expense of systematic research and ethical considerations in mental health studies. Serendipity has undeniably contributed to significant advancements in the science of mental well-being, leading to new treatments and insights. However, it is essential to balance the recognition of serendipitous findings with a commitment to rigorous, systematic research. While serendipity can provide valuable breakthroughs, on-going research and validation are crucial to ensure that these discoveries translate into reliable and effective mental health interventions.

XX. Conclusion

The role of science for the betterment of human life cannot be overlooked. In this vast universe, many of us often ponder the reason and purpose of our existence. Never ending ordeals of some people, society and country perhaps have forced Aldous Huxley to say in his novel "Point Counter Point" that "*Maybe this world is another planet's hell*" [16]. "Whether Huxley is right or wrong that may be debatable but the way socioeconomic policies of the world and global polarization are taking place, it would not take long for the planet earth to fulfil his prediction. What does Huxley's comment have to do with serendipity or this chapter? Apparently, nothing, however, this raises a question. Why do we make progress working so hard and uncovering a large number of secrets of nature in the name of scientific research? The answer is to make human life better on this planet earth. If we agree with this notion, then why is there so much commotion and strife? How do we justify the never ending wars since the dawn of civilization, development of weapons of mass destruction and large scale killing of women, children and elderly people? It is an open secret that the acts of terror across the globe is aided and supported by the government machinery. Seemingly, we are deviating from the main topic of this article. However, the purpose to add this paragraph is to draw the attention of likeminded people that the world does not need weapons of mass destruction instead strategies of large-scale kindness, construction of infrastructure, up gradation and protection of humans and human values and prevalence of peace, prosperity and global order. Advancement of Science alone would prove to be insipid unless we advance our souls, mind, body, thoughts and sensitivities ensuring that we will abide by the rules of humanity, fraternity and much needed brotherhood. We can keep our religious faith at home not to mix it with daily activities in life and avoid being judgmental even under difficult circumstances. We must make a sincere attempt to prove that *Aldous Huxley was wrong.* This planet is not the hell of other planets.

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