SCIENTIFIC WORK OF IMAM AHMAD RAZA

CONTENTS

INTRODUCTION

*"Allah in the name of the most
Affectionate the Merciful".*

We are now entering an era of outstanding achievements in the field of various technologies (modern science). The remarkable scientific developments have provided promising direction for the scholars to make further research in various faculties of knowledge.

Regarding modern science, I have tried to aware the nation about the creative scientific work of Imam Ahmad Raza, the renowned scientific theologian of the 20th century, in various of spheres of knowledge. It is astonishing that such creative work was written one century ago when such type of facilities were hard to find in this subcontinent. Each chapter reflects new findings in research and their applied significance. The chapters are organized to present a scientific approach that explains how Imam Ahmad Raza worked. At the end of each chapter are references that contain classic works and the most recent research publications.

Dr. Muhammad Maalik

CREATIVITY

Many psychologists believe that personality characteristics play an important role in creative thinking.

On the basis of various studies, creative people appear to share certain personality characteristics in common. Evidence obtained from objective and subjective personality tests indicates that "original" or "creative" people tend to have the following traits:

- They prefer complexity over simplicity and some degree of apparent imbalance in phenomenon.
- They are more complex psychodynamically and have greater personal scope.
- They are more independent in their judgment.
- They are more assertive and dominant.
- They reject suppression as a mechanism for the controle of impulse.
- They have preference for intuition.
- They have a breadth of interests.
- They have high energy levels.
- They have an emphasis on aesthetic factors.
- They have a sense of own creative ability.

Creative people may be non-conformists and less restricted by conventional thinking than non-creative people. They are often more concerned with new ideas than with material success and for that reason they are sometimes perceived as "difficult students in school life."

CREATIVE THINKING & INTELLIGENCE

Creative people are generally high in intellectual ability and are mostly talented in some special way e.g. arts, science, poetry or mathematics etc.

In other words, they have certain special abilities that they can use in their search for new ideas. Studies of high creative people in the fields of arts, literature, science and mathematics indicate that they usually obtain high scores on intelligence tests. It is not astonishing because creativity requires knowledge and the ability to relate ideas to one another. Possibly the information processing model will be more useful in the study of creativity. The ways, in which we receive, organize, store and retrieve information very likely, have an effect on the creative process.

Creative thinking is not an idle exercise or fantasy, it requires a store of prior knowledge and the ability to perceive new and important relationships in the existing ideas and phenomenon. The ability to perceive new relationship results in turn, in new ideas, new methods, new solutions or even new problems. The thinkers whom we tend to regard as the most creative are those who produce insights that transform the fields in which they are working and who have a profound impact on the culture to which they belong. Also they know what others have done and activity seek to find a better or more efficient way.

CREATIVITY CAN BE MEASURED BY:

- Convergent thinking
- Divergent thinking

CONVERGENT THINKING

It is the ability to come up with a single correct or best answer.

DIVERGENT THINKING

Divergent thinking is the ability to come up with new and unusual answers to a problem.

Creativity seems to involve more than just diverging thinking. Motivation, prior knowledge, training, independence of spirit and purposefulness, all have a role in producing creative work.

The creative thinker, whether artist, poet, writer or scientist is trying to create something "new under the sun."

STAGES OF CREATIVE THINKING

Creative thinking is that it proceeds in five stages:

- Preparation
- Incubation
- Illumination
- Evaluation
- Revision

A good modern day example of creative thinking in which these stages can be found is the discovery of structure of the genetic molecule deoxyribonucleic acid (DNA) by Watson and Crick in 1957. Watson described this discovery in his book, "The Double Helix". An Asian Muslim Scientific Theologian, Alahazart Imam Ahmad Raza Khan Bareilvi (1856-1921) discussed about Genetics in his book "Assum Sam Ala Mushaquq-

fi-Aia Ulumel Arham 1896". This discussion is now known as Genetic control of Protein Synthesis.

PREPARATION

In this stage the thinker formulates the problems and collects the facts and material considered necessary for the new solution.

INCUBATION

It signifies a period in which the active search for solutions is suspended. During this stage gapes in our knowledge are filled in and we are often able to make creative connections.

ILLUMINATION

When the solution to the problem suddenly pops into the mind, or falls into place, we experience a shock of discovery, called eureka, which means "I have found it." So it is an insight experience; an idea for the solution suddenly swells up into consciousness.

EVALUATION

We have to decide how our solution is. If we decide that the problem is indeed solved, the process is completed. There may be more than one possible solution, and we then have to determine which one is the best. However, if we don't feel satisfied with our solution, we can continue to work on the problem until we arrive at a more satisfactory   solution. In some cases, the insight is generally satisfactory but needs some modification or the solution of minor problems to be a really "good" new idea. Thus, stage 5, revision is reached.

This stage description gives us a general picture of the steps frequently involved in the solution of problems by our most talented and creative people.

The product of creative thinking may a new and unique way of conceptualization the world around us.

Creative scientists think about their own discoveries and those of others, inventing new ways of studying nature and new theories to tie the discoveries together. Creativity may seem a "more exalted topic" than problem solving; it is, in fact, reasonable to think of creativity in terms of solutions to problems.

Newton's law of gravitation, Einstein's theory of relativity, Freud's theory of unconscious, Shakespeare's playwriting, Henry Ford's establishment of assembly-line production. The U.S. government's creation of social security system, Alahazrat Imama Ahmad Raza's formulation of ultrasound technology: basic mechanism of

telecommunication system (including internet technology), currency note, Gastrointestinal Physiology, Auditory theory reformative formula of earning& income (saving & investment), value of π (3.141592265) topological theory, Rizvi model of personality formation, ideas of genetic control of protein system, organized knowledge of Shariat law with its Gradation. Kinds of stones, Evolution theory of human being----- all of these are examples of creativity, the ability to see things in a new and unusual effective solution.

Creative thinking is, of course, not confined to the sciences. The difference between Art and Science is not that Art involves more creativity than science, but rather that science produces abstract knowledge whereas Art produces symbolic knowledge.

The realities tell us that there is no dearth of renowned creative thinkers in the history of Islam who made rich contributions in various fields of knowledge through their divine qualities of learning, wisdom and insight.

Amongst them, the most outstanding, multi dimensional, versatile creative thinker of 20th century is Alahazrat Imam Ahmad Raza Khan Qadri Bareilvi (1856-1921).

ASIAN MUSLIM CREATIVE THINKER

Imam Ahmad Raza was outstanding from the very beginning on account of his extensive learning and superb intelligence. He was born in India (U-P.Bareili) in1856. He started his education at the age of 2 1/2 years. He completed the Holy Quran at the age of 4 years. His first speech was at the age of 6 years on the topic of Melad-e-Rasool for 2 hour duration. His maiden literary work in Arabic was at the age of 8 years. He completed his education at the age of 13 years 10 months and 5days and at that time he was the author of few books. He continued writing so prolifically that his head and heart had surging waves of knowledge, which were hard to restrain.

According to the latest study, Imam Ahmad Raza had a full command over 200 faculties of knowledge (the highest diversity of knowledge in this century). He wrote more than 1000 books including Islamic sciences and current sciences like:

Physics, Chemistry, Biology, Psychology and Parapsychology, Phonetics and Phonology, Engineering and Technology, Astronomy and Astrology, Theory of atomic Technology, Basic mechanism of telecommunication system, Mathematics, Algebra, Geometry (specially spherical Trigonometry), Topology, Hydrodynamics, Applied Chemistry, Ultrasound technology with the presentation of following theories:

- Auditory theory

- Wave theory of sound,
- Corpuscular theory of light,
- Wave theory of light,
- Total internal reflection
- Laws of light
- Sound theory of light,
- Earth theory,
- Theory of tides,
- Chemical bonding theory,
- Combustion theory,
- Atomic theory,
- Fluid dynamics
- Evolution theory of human being,
- Theory of personality formation,
- Medical science like
  * **Gastrointestinal physiology,**
  * **Genetics & Medical Embryology,**
  * **Leprosy,**
  * **Plague.**

This fact can not be denied that such versatility and intensity of knowledge is found neither in his contemporaries nor after him because at the same time he was a translator of Holy Quran (Kunzul Iman) commentator, Muhaditeh, Jurist (Faqhe), reformer of Islam (Mujadded), great saint, Astronomer, Astrologist , Philosopher, Great poet, Economist, Educationist, Psychologist, Politian, Scientist but his distinctive quality is that he was a staunch follower of Sharia in thought and action and a devotee of the Holy Prophet (Peace Be Upon Him) to the deepest chambers of his heart. Undoubtedly, such types of leading figure of very high standing, born rarely in the nation.

Few examples of creative work of the creative thinker of 20th century, Alahazart Imam Ahmad Raza is briefly discussed here:

CURRENCY NOTE (ECONOMICS)

In 1905, the concept of currency note was a new phenomena and most learned men were still searching for the correct solution of this new invention. When Imam Ahmad Raza was asked to respond to12 questions in relation to currency note by the scholars

of Hermain Shareefain, he advanced a full explanation about currency note and elaborated the Islamic thoughts about banking system without interest by writing an Arabic book "Kifl-ul-Faqeehil fehim Fe Ahkam-e-Kirtas Drahim1905" so he surpassed the renowned scholars at that time.

TELECOMMUNICATION SYSTEM

Imam Ahmad Raza, as a Muslim scientific theologian and the creative thinker of the 20th century has discussed the basic mechanism of Telecommunication System in his book "Al Kashf-e-Shafia Hukme Phono Gharafia 1909" covering the topics of:

- Sound theory
- Wave theory
- Auditory theory
- Damped harmonic Motion
- Law of collision etc.

(Note: For detail consult: "Imam Ahmad Raza & Modern Telecommunication System" by Dr. Muhammad Maalik)

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1) Introduction to psychology

    By: Clifford T. Morgan

2) Psychology

    By: Diane E. Paplia

3) Psychology

    By: Robert E. Silverman

4) Simply Psychology

    By: Michael Eysenck

            Royal Halloway University of London

5) An introduction to psychology

    By: M. Wallance

            Joffery H. Goldstain

6) IQ of Imam Ahmad Raza

    By: Dr. Muhammad Maalik

7) Fatawa Rizzawia vol-23rd

By: Imam Ahmad Raza

- In early childhood, play begins a solitary activity. This is followed by parallel play, cooperative play and finally, true peer interaction.

PERSONALITY FORMATION (PSYCHOLOGY)

Psychology is the branch of science, which deals with the human behaviour and mental process. The terms "psychology" comes from the Greek words "Psyche" the (soul) and "logos" the (study).

Personality is the constellation of relatively consistence ways of dealing with people and situation that make each person unique.

Personality can be defined as it consists of distinctive patterns of behaviour (including thoughts and emotions) that characterize a person's adaptation to the situation of his or her life.

Personality has been defined in different way by the psychologists. From Hippocratus to Sigmond Freud, the psychologists have discussing various theories about personality.

FAMOUS FIRSTS IN PERSONALITY FORMATION

The renowned psychologists who elaborated personality theory are named as:

- Sigmund Freud   (1856-1939)
- Alfred Adler   (1870-1937)
- Carl Jung   (1871-1937)
- Karen Horney   (1885-1952)
- B.F.Skinner   (1904)
- Erik Erikson   (1904)
- Erik Fromm   (1941)
- John B.Watson   (1924)
- Albert Bandura   (1925)
- Carl Rogers   (1902)
- William H. Sheldon   (1898-1977)
- Gordon W. Allport   (1897-1976)
- Alahazrat Imam Ahmad Raza Khan Bareilvi

(1856-1921)

Here we discuss the theory of personality formation offered by Imam Ahmad Raza and Sigmond Freud.

   Imam Ahmad Raza   **(1856-1921)**

   And Sigmund Freud   **(1856-1939)**

Imam Ahmad Raza, the creative thinker of 20ᵗʰ century constructed a model of personality structure with 3 interlocking part in his "**Malfuzatt Part-III"** before 1921 as:

   Imam Ahmad Raza   **Sigmond Freud**

■ NAFS ------------------------------ ID

■ QALB ----------------------------- EGO

■ RUH (SOUL) --------------------- SUPER EGO

But much before in 1859 (at the age of 3 1/2 year) Imam Ahmad Raza said:

"Jub nazar behkti hai, tub dil behkta hai, ur jub dil bhkta hai, tu sattar behkta hai."

In the light of applied psychology, this above mentioned psychoanalytic wording of Imam Ahmad Raza is very important in personality formation.

The most famous personality theorist the world ever has known, Sigmond Freud revolutionized people's thinking about the development of personality in1932.

In Freud's view there are three different parts of personality structure, (already discussed by Imam Ahmad Raza as):

■ ID   ------------------------------ (NAFS)

■ EGO   ----------------------------- (QALB)

■ SUPER EGO----------------------------- (RUH - SOUL)

ID: Which operates on the pleasure principle and wants immediate gratification of instinctual needs.

EGO: The EGO, which operates on the reality principle, tries to find acceptable ways to gratify the ID.

SUPER EGO: The Super Ego represents parental and social values (prohibitions).

  It corresponds closely to what one commonly calls the conscience.

REFERENCES:

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  By: Clifford T. Morgan

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7) Mulfoozat-i-Ala Hazrat Part-III

   By: Imam Ahmad Raza Khan Bareilvi

8) Imam Ahmad Raza & Personality formation

   By: Dr. Muhammad Maalik

9) Islamic Concept of Human Nature

   By: Prof. Dr. Muhammad Tahir-ul-Qadri

10) Musnad Imam Ahmad (quoted in) Tafseer Ibn-Kaseer, Vol-3rd Page. 432.

11) Ibid.

PSYCHOLOGY

Psychology is the scientific study of human behaviour and mental processes. The term "Psychology" comes from the Greek words"PSYCHE" (the soul) and "LOGOS" (study)__ the study of soul (later of the mind).

As a science, psychology is comprised of systematized knowledge that is gathered by carefully observing and measuring events.

According to Clifford T. Morgan, psychology is defined as © ©"the science of human and animal behaviour; it includes the application of this science to human problems.

Psychology is not the only branch of knowledge which studies human and animal behaviour but Anthropology,

Sociology, Economics, Political science, Geography and History also study various aspects of behaviour, and together with psychology comprise the group of knowledge area known as the behavioural sciences. The study of behaviour is also a part of several Biological sciences----Zoology, Pharmacology,Physiology and neurobiology. For example, Anthropology compares behaviour across cultures; Sociology studies the behaviour of people in groups and Economics is concerned with the behaviour involved in the exchange of goods and services.

Behaviour is defined as actions that can be readily observed, such as physical activity and speaking , as well as other mental processes that occur even though they cannot be observed directly such as perceiving,thinking,resembling and feeling.

BIOLOGY OF BEHAVIOUR

(Biological Foundations of Behaviour)

The Biology of behaviour is the study of the relationship between behavioural and mental events - memory, learning, perception, motivation-and speech -and process in the nervous system-particularly in the Brain.

The relationship of behaviour with nervous system in relation to psychology is named physiological psychology but it is also called Biological psychology, Biopsychology, neuropsychology, psychobiology and psychophysiology.

From above, it is concluded that physiology (Branch of Biology) has the fundamental concern with behaviour. So psychology includes the study of structures that are involved in behaviour, Sense organs, the glands, the muscles and the nervous system-nerve cells (Neurons), neurotransmitters, C.N.S and peripheral nervous system, thalamus, hypothalamus and the cerebrum etc.

The conclusion is that the study of behaviour requires a knowledge of these structures.

HISTORY OF PSYCHOLOGY

In a sense the history of psychology reaches back to ancient times when philosophers and religious leaders were asking questions about human nature and trying to explain human behaviour.

It is important to note that Islamic ideology about creation of man signifies the concept of human nature and behaviour. The comprehensive concept about human nature has been discussed 1400 years before in the Holy Quran and Hadith.

According to the saying of the Holy Prophet صلى الله عليم وسلم

(9)   كل نسمة تولد عُلى فطرة

Trans: Every child is born on the right nature.

Another saying of the Holy Prophet صلى الله عليم وسلم.

(10)   كل مولوده يولد علٰى فطرة

Trans: Every Child that is born conforms to the right path. This right path is known as فطرت سليمہ. In other words we can say that the child whether borns in a Muslim or non Muslim home contains the potential of fair thinking and fair doing.

Regarding to philosophy of Human nature and behaviour, there are two aspects of Human personality.

1: Potential nature.   فطرت با لقوه

2: Actual nature.   فطرت با لفعل

Regarding behaviour, the Human potential nature means that every man possesses an urge and demand in his nature to distinguish between right and wrong.

The Holy Quran says:

91: 7,8,9,10 ونفس و ما سوّٰها فا لهما فجورها و تقوٰها

Trans: And by life and by the one who made it perfectly. And put it into the heart the qualities of good and evil. كنزالايمان

Regarding behaviour, the actual human nature means the basic instincts, ambitions and various desires in a person, are responsible for behaviour.

The Holy Quran says:

زين للناس حب الشهوٰ ت من النساء   3: 14

Trans: For mankind have been arranged on levels according to their desire, there love of women and children, silver and gold, branded horses and (cattles)animals and crops. This is the wealth of the living world; and it is Allah with these is an excellent destination.(Kanz-ul.Iman).

So, in psychology, Behaviour has fundamental role for personality formation.

FAMOUS FIRSTS IN PSYCHOLOGY

The history of psychology as a science is round about 100 years old shown by some of its milestones.

1: 1875-1876   William James: -First course   Havard university in experimental psychology.

2: 1878   G.Stanley Hall-America: -First

   Ph.D in psychology.

3: 1879   Wilhelm wundt -Leipzig

   (Germany): -First laboratory for   psychological research.

4: 1881   Wilhelm wundt (Germany): -   First   professional journal of psychology in the world.

5: 1886   John Dewey:- First American   textbook in psychology.

6: 1887   G.Stanley Hall: - First   professional American journal

   of psychology.

7: 1888   First professorship of   psychology in the world was

   established at the university of Pennsylvania naming James

Mckeen Cattell.

8: 1890   William Jame's classic

   textbook: - The principles of psychology.

9: 1892   G.Stanley Hall: -First president

   American psychological   association.

10: 1856-1921   Alahazrat Imam Ahmad Raza Khan Bareilvi: -

Introduction to child psychology and theory of personality   formation.

Psychology is, in effect, the child of two parents.   Philosophy:

(The persuit of wisdom throughlogical reasoning and

Physiology:

(The study of the vital life processes of an organism)

Psycholog's research to understand how people think,feel, and act continues to rest on human Biology.

SCHOOLS OF PSYCHOLOGY

There are various schools of psychology because of basic differences with reference to very nature of human beings.

(1) STRUCTURALISM

Wilhelm wundt MD (1832-1920): - Originator of psychology__he wanted to study the basic structure of human mind by developing the method of analytic introspection.

Edward Bradford Titchener (1867-1927):__ Worked with his teacher, Wilhelm wundt and claimed that structure of human mind was made up of more than 30,000 separate sensatios, feelings and images and nothing else.

(2) FUNCTIONALISM

A significant movement in psychology, called functionalism began in 1890 with a publication of principles of psychology by William james (1842-1910)

Functionalism means the function of mind and behaviour. Functionalists like William james ,John Dewey(1859-1952)and James R.Angell (1869-1949) and Harvey Carr (1873-1954) proposed that psychology should "what mind and behaviour do". Specifically, they were interested in the fact that mind and behaviour are adaptine-they enable an individual to adjust to a changing environment. They did experiments on the ways in which learning, memory, problem solving and motivation help people adapt to their environment.

(3) PSYCHOANALYSIS

Sigmond Frued (1856-1939) pioneered   another movement psychoanalysis, he complemented Wundt psychology of consciousness with psychology of unconsciousness.

Frued developed a theory of behaviour and mind based on urges and drives which are hidden from the awareness of the individual -unconscious. It is the expression

of unconscious drives, which shows up in behaviour and thought. The term unconscious motivation thus describes the key ideas of psychoanalysis.

(4) BEHAVIORISM

This school of psychology was originated with John B.Watson (1879-1958). He rejected mind as subject of psychology and insisted that psychology be restricted to the study of behavioural activities of the people and animals.

The Behaviourists replaced introspection as a research method with laboratory studies of conditioning, a type of learning. They emphasized

the role of the environment in shaping human nature and played down hereditary characteristics.

In short Behavourists major contribution was its use of the specific method to study behaviour.

(5) GASTALT PSYCHOLOGY

This school of psychology was founded in Germany about 1912 by MAX WERR-HEIMER (1880-1943) and his colleagues KURT KRIFFA (1886-1941) and WOLFGANG KOHLER (1887-1967). They mentioned that the mind is not made up of a combination of simple elements but the "GASLTALT" (German word means form or configuration or pattern or whole) the form or pattern that these elements form.

So the Gastalt psychologists mentioned that the mind should be thought of as resulting from the whole pattern of sensory activity and the relationship and organizations within this pattern.

(6) HUMANISTIC PSYCHOLOGY

This branch of psychology often called "third force" - after behaviorism and psychoanalysis. In the early 1950 it has been advocated by ABRAHAM MASLOW (1908-1970) and Carl Rogess (1902).

Humanistic psychology focuses on growth objections such as Self-actualization, creativity and fullness of being. Humanism has been sought to expand the concept of psychology to include such uniquely human experiences as love, hate, fear, hope, happiness, humour, affection, responsibility and the measuring of life, all of which are aspects of our life.

(7) COGNITIVE PSYCHIOLOGY

The word "COGNITION" refers to perception of the world around us, some aspects of learning, memory, thinking and comprehension of our social environment. It refers to the processing of information that are receive through the senses.

Cognitive school of psychology seeks to find out what kinds of thought process go on in the mind.

Cognitive psychologists are not concerned with analyzing behaviour in terms of simple stimulus-response connections rather to understand the ways by which the mind processes the information it perceives are organizes, remembers and uses.

In short, the study of cognitive concerns itself with the capabilities of the human mind, including the acquisition, storage and retrieval of information, the role of language and the process of thinking.

(8) ISLAMIC PSYCHOLOGY

Islamic psychology was founded 1400 years back in the Holy Quran and Hadith. But in this era (Indopak) this school of psychology was explained fully by the renowned Asian Muslim theologian of the 20th century, Alahazrat Imam Ahmad Raza Khan Bareilvi (1856-1921). This theory particularly

explains the humanistic psychology, cognitive psychology, functionalism and also behaviourism. He stresses the human behaviour in relation to social environment. The important thing is that the Islamic psychology tells up thoroughly about the human nature that every child contains the potential of fair thinking and fair doing but regarding behaviour the environment has a key role in personality formation. So Alahazrat as a psychologist has a deep and comprehensive study about human psychology in relation to human behaviour and personality formation:

AREAS OF SPECIALIZATION IN PSYCHOLOGY

It is interesting to note that psychology is a complex science with many different ways of looking at the human mind and the behaviour and of applying the knowledge acquired.

The field of psychology is varied, so major sub fields of psychology are just named here: -

- Clinical psychology.
- Counselling psychology.
- Educational and school psychology.
- Experimental psychology.

- Physiological psychology.

- Developmental psychology.

- Personality psychology.

- Child psychology.

- Industrial and organizational psychology.

- Engineering psychology.

- Spiritual psychology.

DIMENSIONS OF PSYCHOLOGY

Psychology has many areas of interest and variety of methods and settings. For convenience, breadth and scope of psychology is viewed in terms of its: -

- Subject matter.

- Aims and methods.

- And the settings in which psychologist work.

(A) The Subject Matter

In this text we identify several general areas of psychology as Behaviour, perception, conditioning, cognition and memory, language, thought, intelligence & measurement, consciousness, motivation, the development (of the individual) personality, adjustment, abnormal psychology, therapies.

(B) Aims and Methods

The psychologists generally concentrate their efforts on one of the activities: -

- Pure research.

- Applied research.

- Practical applications.

(C) The settings:-

Psychologists work in a variety of settings:

a) Teaching in colleges and universities.

b) Clinical settings as laboratories and community health center.

METHOD IN PSYCHOLOGY

Psychology as a science was emphasized

that discovery of new knowledge about behaviour is based on experiment method and observation method.

(1) EXPERIMENTAL METHOD

The basic feature of experimental method is the controle of all variables.

A variable is an event or condition which can be measured and which varies quantitatively.

Variable may be either,

i: Independent variable.

ii: Dependant variable.

Psychologists design experiments to that hypothesis about causes and effects. They manipulate or change one aspect of situation called independent variable and observe its effect upon one aspect of behaviour called dependant behaviour.

(2) OBSERVATION METHOD

(SYSTEMIC OBSERVATION)

Two basic techniques of systemic observation are used in psychological research.

a) Experimental method- in which the investigator manipulates events to observe what happens.

b) Correlation method- in which the investigator observe naturally occurring events.

Imam Ahmad Raza says that;

Regarding development and personality formation, early education and training should be on Islamic basis.

Child parent relationships and child teacher relationships, based on Islamic method, play a key role to administer displine in future life of the child.

Schools are central to the lives of children during later childhood, and improve children's thinking in a number of general ways during adolescence.

IMAM AHMAD RAZA AND FLUID DYNAMICS

The concept of fluid dynamics (hydrodynamics) is one of the most important in the world of science. The goal of this subject is to provide an understanding about nature and properties of fluids because the behaviour of fluids is fundamentally important to researchers in the life sciences.

Matter is normally classified as being in one of the three states-solid, liquid, or gaseous. Often this classification system is extended to include a fourth state referred to as **Plasma**. When matter is heated to temperatures, many of the electrons surrounding each atom are freed from the nucleus. The resulting substance is a collection of free electrically charged particles-negatively charge electrons and positively charged ions. Such a highly ionized substance containing equal amounts of positive and negative charges in plasma.

The research study tells us that Plasmas exist inside the stars. For example, if we were to take a grand tour of our universe, we would find that there is a far more matter in the plasma state than in the more familiar solid, liquid, and gaseous states because there are far more stars around than any other form of celestial matter.

Our everyday experience tells that a solid has definite volume and shape, a liquid has a definite volume but no definite shape, while a gas has neither definite volume nor definite shape.

Scientists continually work at improving our comprehension of fundamental laws and new discoveries are being made everyday. In many research areas, a great deal of overlap occurs among Physics, Chemistry, and Biology. The numerous recent technological advances are results of the efforts of many scientists, engineers, and technologists. Some of the most notable include unmanned space mission and manned moon landings, microcircuity and high-speed computers, fluid dynamics (hydrodynamics), and sophisticated imaging techniques used in scientific research and machine. The impact of such developments on our society has indeed been great and it

is likely that future discoveries will be exciting, challenging and of great benefit to humanity.

Because this topic is concerned with the laws of physics like fluid dynamics-hydrodynamics, we must discuss by clearly defining the physical quantities as:

- Ideal fluids
- Viscosity
- Drag force
- Stoke's law
- Terminal velocity
- Equation of continuity
- Bernoulli's equation
- Application of Bernoulli's equation,
- It is of great interest that an eminent, scientific theologian of the 20th century, Imam Ahmad Raza Khan has discussed these physical quantities in detail in his book **"Ad-diqatu-wat-Tibyyan leilm-e-RIqqat-e-Wassailan 1915."**

FLUIDS IN MOTION

When a fluid is in motion, its flow can be characterized in one of the two ways:

- Streamline or laminar flow
- Turbulent or irregular flow

If every particle that passes a particular point, moves exactly along the smooth path followed by particles that passed that point earlier. The path is called a streamline. The research study tells us that different streamlines cannot cross each other under this steady flow condition, and the streamline at any point coincides with the direction of fluid velocity at that point.

Turbulent flow-the flow of a fluid becomes turbulent or irregular, above a certain velocity or under any conditions that can cause abrupt changes in velocity. Irregular motion of fluid, called eddy currents, are characteristics in turbulent flow.

Regarding fluid flow, viscosity is used for the degree of internal friction in the fluid. This internal friction is associated with the resistance between two adjacent layers of the fluid moving relative to each other. Many features of fluid motion can be understood by considering the behaviour of an ideal fluid.

Hydrodynamics describe fluids in motion, including the flow of placid streams, eddies in a pond, mud slides, smoke rings, ocean waves and tides, arterial blood flow, Jupiter's (and the earth's) atmosphere, the rotational flow of a galaxy, and nuclear fission

FLUID DYNAMICS (DEFINITION)

Fluid Dynamics is the branch of Mechanical Physics which deals with the characteristics of fluid in motion.

FLUIDS: (Liquids and gases)

Fluid is a substance which when at rest can not sustain shear forces (i,e a force exerted tangentially to the surface on which it acts).

Matter has three conditions:

- Solids
- Liquids
- Gases

Liquids and gases can flow so called fluids. This flow of fluids is called fluid dynamics. On the other hand, when fluids can not flow, known as fluid statics.

IDEAL FLUIDS

Every fluid is compressible and has resistance power during flow (viscous).

Ideal fluid or perfect fluid is incompressible and non viscous. In the motion of such a fluid, two contacting layers experience no tangential forces but act on each other with normal forces (pressure) only.

GENERAL CHARACTERISTICS OF FLUID FLOW

Some general characteristics of fluid flow are as follows:

- Fluid flow can be steady or non-steady.
- Fluid flow can be compressible or non-compressible.
- Fluid flow can be viscous or non-viscous.
- Fluid flow can be rotational or irrotational.

APPLICATION OF FLUID DYNAMICS

Fluid Dynamics is of great importance regarding its application in the:

- Filter Pumps
- Atomizers
- In the flow of air over an Aerofoil, venturimeter, and

- In blood circulation

- The main objective of this subject is to understand that viscous forces in a fluid cause a retarding force on an object moving through it.

- Understand the steady (laminar, streamline) flow, incompressible flow, non-viscous flow.

- Transition from laminar to turbulence flow of a viscous fluid at a sufficiently high velocity.

- Understand the law of conservation of mass relating equation of continuity.

- Understand the law of conservation of energy-the basis of Bernoulli's theorem.

- Understand the equation of continuity and the Bernoulli's theorem along with their application in process of aero-plane and blood circulation.

- Understand that the pressure difference can arise from different rates of flow of a fluid (Bernoulli effect).

- Understand the qualitative explanations for the swing of a spinning ball.

- Understand the equation of continuity Av = Constant for the flow of an ideal and incompressible fluid.

- Understand the viscous Drag and Stokes law regarding the terminal velocity a spherical body falling through a viscous fluid under laminar conditions.

FAMOUS FIRSTS IN FLUID DYNAMICS

- Torricillis   1608-1647(Italian Physicist).
- Leonhard Euler   1707-1783 (1755).
- Joseph Loius Lagrange.(1736-1813)
- Navier   (1827).
- Robert Brown   (1827).
- Daniel Bernoulli   (1700-1782).
- Sir. Gorge Stokes   1819-1903 (1845).
- Orborne Reynald   (1883).
- Parandtl   (1904)
- Jean-Louis-Marie Poiseuile   (French Physcian).

  (who first investigated the flow of fluids through tubes as an aid in understanding the circulation of blood).

- T. Von Karman   (United States) 20TH century
- G-T. Taylor   (England)   20TH century

■ Alahazrat Imam Ahmad Raza Khan Bareilvi

(1851-1921)-INDIA

(the renowned Asian Muslim Theologian of the 20Th century who discussed about laminar blood flow in 1886 & 1915, he also discussed about Fluid Dynamics (especially Hydro Dynamics) regarding continuity of flow, viscosity of various fluids, drag force, streak line flow, various characteristics of water, kinds of water (306 kinds of water), classification of solutions, binary solution, saturated solution, super saturated solution, crystallization, etc. in his book:

Al-Diqat-i-Wattibian La Ilm-i-Riqit-i-Wassailan 1915).

In this book, regarding ablution (Wuzu), Imam Ahmad Raza has discussed in detail about Hydrodynamics. He explained 306 kinds of water. Out of this, there are 160 kinds of water, the ablution is permissible and there are 146 kinds of water, with which ablution can not be made

MODERN DESCRIPTION

Viscosity, Drag force and Stokes' law

VISCOSITY

Viscosity is the internal resistance of friction between the adjacent layers moving relative to each other in a fluid that is the frictional effect between different layers of a flowing fluid. Viscosity measures the force required to the sliding motion of one fluid layer over another. Some substances are more viscous than others. Substances that do not flow easily have larger viscosity such as thick tar and honey. Substances that flow easily have small viscosity such as water (this has been discussed in detail by Imam Ahmad Raza).
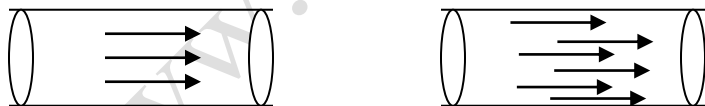
This figure shows an idealized picture of the velocity profile for the type of fluid flow through a pipe. For a real fluid, the liquid near the surface of the pipe is at rest, and the velocity profile is parabolic. Such flow is referred to as poiseuille flow, after Jean-Louis-mare Poiseuille who studied blood circulation. The reason for this affect is the internal friction of the fluid, or viscosity. The concept of internal friction has a sound basis in the description of a fluid as a collection of molecules in motion. In addition to the molecules "going with the flow" they also have a random motion.

MECHANISM OF VISCOSITY

If two layers of fluid flow with slightly different speeds, the random sidewise intrusion of some slower molecules into the faster steam will tend to slow down the faster stream, whereas intrusion of faster molecules into the slower stream will tend to speed up the slower stream. This is the basic mechanism of viscosity. To better understand the concept of viscosity, consider a liquid layer placed between two solid surfaces (glass plates). It is easier to accomplish with water than with molasses, and the ease depends on the viscosity. To quantify this effect, a force F is applied to the upper plate, so that it is in motion at constant velocity v relative to the lower plate, which we assume to be at rest. The force F opposes the viscous drag on the upper plate to keep its viscosity constant. However, in viscous fluids, there are cohesive forces between molecules in the various layers that can lead to strains that change with time. By definition, the shear stress on the liquid is,

Shear stress = F/A

Where,   A is the area of the top plate. Further more, the shear strain is defined as:

Shear strain = $\Delta x/L$

The velocity of the fluid changes with zero at a lower plate to v and v at the upper.

Thus, in a time Δt, the fluid at the upper plate moves a distance Δx is $= \upsilon \, \Delta t$

Therefore,

$$\text{Shearing strain} = \Delta x/L = \frac{\upsilon /L}{\Delta t}$$

This equation states that the rate of change of the shearing strain is υ /L.

The Coefficient of viscosity (n), for the fluid, is defined as the ratio of the shearing stress to the rate of change of shear in strain.

$$n = \frac{FL}{AV}$$

If the fluid is not confined to a narrow region between two plates, so that the velocity changes across the profile of the laminar flow, we get general definition of the coefficient of velocity.

$$F = n_A \frac{\partial V}{\partial y}$$

A practical application of viscosity occurs in the fluid flow through cylindrical pipes. The flow is again laminar, but in this case the layers of fluid are thin walled cylinders of varying radii. The flow velocity varies with the radius, its maximum value occurs on the axis and its minimum value which we assume to be zero, at the walls.

In case of cylindrical pipe the variation of the velocity with locations across the pipe is not linear. Assuming once again that the layer next to the walls is at rest, the velocity in the cylindrical shell of radius r can be.

$$v = vo \left(1 - \frac{r^2}{R^2} \right)$$

where Vo is the velocity at the centre of the pipe. In terms of pressure difference ΔP across the length L of the pipe, the central velocity is

$$vo = \frac{(P_1 - P_2) R^2}{4nL}$$

or
$$vo = \frac{\Delta p R^2}{4nL}$$

by considering the flow through each thin cylindrical shell we can show that the total mass flux dm/dt (fluid mass flowing through the pipe per unit time) is

$$\frac{dm}{dt} = \frac{P \pi R^4 \Delta P}{8nL}$$

This result is known as poiseuille's law. Knowing the co-efficient of viscosity of the fluid, we can then determine the pressure difference that must be provided by an external agent to sustain a given mass flux through the pipe. Equivalently, if we force fluid through a pipe with a known pressure difference, measuring the mass flux permits us to determine the coefficient of viscosity of the fluid.

In short, viscosity in liquids originates with the intermolecular cohesive forces. As the temperature increases, the coefficient of viscosity of a liquid decreases because the increasing kinetic energy of the molecules weakens the effect of the intermolecular forces. But, in gases, the situation is different i.e. the viscosity increases with increasing temperature, because the molecules themselves can migrate between the layers. At higher temperature, there is more molecular motion and therefore more mixing.

DRAG FORCE

An object experiences a retarding force when it moves through a fluid, known as a Drag force or fluid friction. The drag force increases as the speed of the object increases and vice versa.

STOKES' LAW

It states that the drag force F on a sphere of radius r moving slowly with speed through a fluid of viscosity **n** is given by:

$$F = 6 \pi \eta r v$$

This shows that the drag force depends upon:

- Viscosity of the medium (n)
- Radius of the medium (r)
- Speed of the sphere (v).

TERMINAL VELOCITY

It is the maximum velocity of a vertically falling water droplet when its acceleration becomes zero.

EXPLANATION

Consider a water droplet such as fog, which is following vertically downward. The upward drag force on the water droplet increases as the speed of droplet increases. The net force on the droplet in given by:

Net force = Weight-Drag Force

Net force = mg- $6 \pi \eta r v$

As the speed of droplet continues to increase the drag force eventually approaches the weight in magnitude.

π
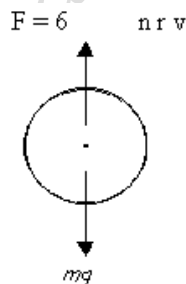
thus $mg = 6\,\pi\,r\,v$

so   Net force $= 6\,\pi\,\eta\,r\,v - 6\,\pi\,\eta\,r\,v = 0$

         Net force $= 0$

This means droplet is falling with uniform velocity, known as Terminal Velocity of the droplet.

To find out Terminal Velocity Vt, we use Stokes' law for the drag force. Equating it to weight of the drop,

we have $mg = 6\,\pi\,\eta\,r\,Vt$

         $Vt = mg / 6\,\pi\,\eta\,r$

Let "P" be density of the droplet,

$$p = \frac{m}{v}$$

$$m = pv$$

Where volume $V = 4/3\,(\pi\,r^3)$

         $M = 4/3\,(\pi\,r^3)\,.\,p$

Substituting this value in the above equation, we get,

$$Vt = 2\,g\,r^2\,p / 9\,\eta$$

Since, $2\,p\,g / 9\,\eta = $ constant

This shows that

$$Vt \propto r^2$$

EQUATION OF CONTINUITY

Equation of continuity plays a fundamental role in fluid dynamics.

■ The product of cross sectional area of a pipe and fluid speed at any point along the pipe remains constant.

■ The rate of flow of a fluid through any pipe remains constant.

EXPLANATION

Consider a fluid flowing through a pipe of non-uniform size. The flow is streamline and steady so the mass of the fluid at lower end A1 is, $\Delta M_1 = P_1 A_1\,\Delta X_1 * \Delta t$. Similarly mass of the fluid at upper end V_2 is, $\Delta M_2 = P_2 A_2\,\Delta X_2 / \Delta t$.

Therefore, the mass of fluid entering will be equal to the mass of the fluid leaving the pipe. And if the fluid is incompressible and the flow is steady, the mass of the fluid is conserved. So $\Delta M_1 = \Delta M_2$

$$P_1 A_1 \; \Delta t = P_2 A_2 \; \Delta t$$

Since density is constant for the steady flow of incompressible fluid, we get,

$$A_1 V_1 = A_2 V_2$$

This equation is called equation of continuity.

BERNOULLI'S EQUATION

Bernoulli's equation is the fundamental equation in fluid dynamics that relates pressure to fluid speed and height. Applying the principles of conservation of mechanical energy to the steady flow of an ideal fluid leads to Bernoulli's equation,

$$P + \tfrac{1}{2} \rho v^2 + \rho gh = \text{a constant}$$

Bernoulli's equation states that the sum of pressure, kinetic and potential energies per unit volume in a steady flow of an incompressible and non-viscous fluid remains constant. Mathematically it can be written as:

$$P + \tfrac{1}{2} \rho v^2 + \rho gh = \text{a constant}$$

EXPLANATION

Let us consider the flow of an incompressible and non-viscous fluid through a pipe in time t as shown in the figure:

The force on the upper end of the fluid is $P_1 A_1$,

where

P_1 = the pressure

A_1 = area of cross section at the upper end.

The work done on the fluid, by the fluid behind it, in moving it through a distance ΔX_1, will be,

$$W_1 = F_1 \, \Delta X_1 = P_1 A_1 \Delta X_1$$

Similarly, the work done on the fluid at the lower end is $W_2 = -F_2 \Delta X_2 = -P_2 A_2 \Delta X_2$.

The work done W_2 is taken to be negative as this work is done against the fluid force. The net work done

$$= W = W_1 + W_2$$

$$W = P_1 A_1 \Delta X_1 + (-P_2 A_2 \Delta X_2)$$

$$W = P_1 A_1 \Delta X_1 - P_2 A_2 \Delta X_2$$

From equation of continuity,

$$A_1 V_1 = A_2 V_2$$

Hence

$$A_1 V_1 t = A_2 V_2 t = V \text{ (volume)}$$

So equation becomes

$$W = P_1 V - P_2 V$$

$$W = (P_1 - P_2) V$$

And $\quad V = m/p$

$\quad\quad m =$ mass of fluid,

$\quad\quad p =$ density of fluid

Then $\quad W = (P_1 - P_2) m/p$

Part of this work is used by the fluid in changing its kinetic energy and part is used in changing its gravitational potential energy.

Change in K.E $= \frac{1}{2} m V_2^2 - \frac{1}{2} m V_1^2$

Change in P.E $= mgh_2 - mgh_1$

Where h_1 & h_2 are heights of the upper and lower ends from reference level.

Applying the conservation of energy to this volume of fluid, we get,

$$(P_1 - P_2) m/p = \frac{1}{2} m V_2^2 - \frac{1}{2} m V_1^2 + mgh_2 - mgh_1$$

$$\text{or}$$

$$(P_1 - P_2) 1/p = \frac{1}{2} V_2^2 - \frac{1}{2} V_1^2 + gh_2 - gh_1$$

$$(P_1 - P_2) = \frac{1}{2} \rho V_2^2 - \rho V_1^2 + \rho gh_2 - \rho gh_1$$

re-arranging we get,

$$P_1 + \tfrac{1}{2}\,\rho\,V_1^2 + \rho gh_1 = P_2 + \tfrac{1}{2}\,\rho\,V_2^2 + \rho\,gh_2$$

This is Bernoulli's equation and is often expressed as:

$$P + \tfrac{1}{2}\,\rho\,V^2 + \rho gh = \text{constant}$$

APPLICATION OF BERNOULLI'S EQUATION AND THE EQUATION OF CONTINUITY.

There are a number of applications of Bernoulli's equation which explain its use and demonstrate the range of its applicability.

- The venturi flow meter
- The pitot tube
- Dynamic lift
- Thrust on a rocket
- Curve balls and sinkers
- Atomizers in perfume
- Battles and paint sprayers
- Vascular flutter and aneurysms

For convenience, here we discuss only venturi flow meter.

THE VENTURI FLOW METER

This is a device to measure the flow speed of a fluid in a pipe. A fluid of density ρ flows through a pipe cross

–sectional area A. At the throat the area is reduced to "a", and a manometer tube is attached as shown in the figure.

The manometer tube contains mercury (liquid), have a density ρ. By applying Bernoulli's equation and the equation of the volume flux at points 1 & 2, so the speed of flow at point 1 is, $\quad v = \dfrac{a\sqrt{2(\rho' - \rho / gh}}{\rho(A^2 - a^2)}$.

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IMAM AHMAD RAZA & LIGHT THEORY

Scientists have long been interested by the nature and composition of light. The philosophers and theologians have argued endlessly concerning the proper definition and perception of light. As light is the fundamental ingredient of life on Earth, so it is important to understand the nature of light. Regarding its application in the universe, the researches claim that plants convert light from the sun to chemical energy through Photosynthesis. Also the light is the means by which we transmit and receive information from objects around us and throughout the universe.

Here, I mention the name of the renowned physicists and scientific theologians who made rich contributions regarding light theory.

FAMOUS FIRSTS IN LIGHT THEORY

The famous firsts in light theory are:

- Ibin-ul-Hesum   (965 -1039)
- Willebrord Snell   (1591-1626)
- Huygens   (1629-1695)
- Robert Hooke   (1635-1703)
- Isaac Newton   (1642-1727)

- Thomas Young   (1801)
- James Clerk Maxwell   (1865)
- Michelson   (1852)
- Morley   (1931)
- Max Plank   (1859-1947)
- Albert Einstein   (1879-1955)
- Alahazrat Imam Ahmad Raza   (1856-1921) Bareilvi-Asian Muslim theologian of the 20th Century
- Louis de Broglie   (1892-1987)

Amongst the above mentioned renowned scientists, the Asian Physicist Alahazrat Imam Ahmad Raza Bareilvi (1856-1921) is the first brilliant Muslim scientific theologian who made rich creative contributions regarding nature of light and physical optics covering the topics of:

- Nature & composition of light
- Reflection of light
- Refraction of light
- Total internal reflection
- Theories of light
  - ★ Corpuscular theory
  - ★ Wave theory
- Laws of light
- Atmospheric refraction
- Image formation by reflection & refraction
- Reversal of image
- Formulation of Ultrasound machine on the basis of reflection and refraction (Piezoelectric Phenomenon—transmission & reflection).
- Geometric optics

  The above mentioned topics regarding light & optics have been discussed in the books:

- As-sumsam-ala Mushaquk -fe-Ayia ulum-il-Arham 1896
- Ad-diqatu-wat-Tibyan leilm-e-RIqqat-e-Wassailan 1915.
- AlKalem-tul-Mulhamah-fe-Hikma-til-Muhkamah 1919.

(Note: these books have been included in 26th & 27th volume of Fatawa Rizzawia.**)**

Regarding Physical Optics, we discuss the scientific work of Imam Ahmad Raza in the light of modern science.

PROPERTIES OF LIGHT

One of the most striking features of light is that it appears to travel in straight lines. This fact manifests itself in the sharpness of shadows and in the rays that appear when light penetrates dark and dusty room through tiny openings, the image of the outside object is inverted inside the room. This can be understood with the example of Pinhole camera. For simplicity this can be explained as make a pinhole in piece of cardboards and hold the cardboard in front of the candle at a little distance from it. Beyond the cardboard hold up a white screen (B), so that the cardboard is between the screen and the candle. A dim image (D) of the flame will be thrown upon the screen, and it will be noticed that it is upside down so that an inverted image of the flame is formed. This is due to the fact that the cardboard cuts of all the rays of light from the candle except such as can pass through the hole. The only rays from the top of the flame which can pass through the hole are those which are caught upon the lower part of the screen. The image is dim because only a few rays of light can pass through the small hole. Now make another hole a little distance away from the first. Another inverted image of the flame is seen and so on. This has been discussed by Imam Ahmad Raza one century ago.

The modern Physics tells us that light is a form of energy. It travels in a straight line. The light travels vary fast. The main source of light is the sun. The modern research states that light from the sun takes only 8 minutes to travel 150 million kilometers to the earth's surface. This means that the speed of light in space is approximately 300 million meter/sec. Most of the light we see, arrives so quickly that it seems to take no time at all. Light is faster than sound. Light can be blocked by an object to make a shadow. It is important to note that luminous objects emit light and non-luminous objects reflect light. Light itself is not visible but things become visible in the presence of light. We see non-luminous objects by the light they reflect into our eyes.

THEORY OF LIGHT

Today scientists view light as having a dual nature, corpuscular (Particle) theory of light and wave theory of light.

It is important to note that corpuscular theory of light was first discussed by Isaac Newton in 1670. Robert Hook offered an idea that light is some type of oscillatory

activity. This idea led Christian Huygens (Dutch scientist) in 1687 to propose a wave theory of light.

The facts tell us that modern science was introduced in Subcontinent after 1950. It is astonishing that Imam Ahmad Raza, the renowned Asian scientific theologian offered Light theory as a dual nature in his books, As-sumsam 1896, Al-diqutu-wat-tibyan 1915 and Al-kalam-tul-Mulhama 1919.

No doubt, this was a creative work of a genius mind in Asia which should be applauded. Also Imam Ahmad Raza interpreted many fundamental observations concerning the nature of light. His contributions to Physical theories remain important today. On the basis of this theory, he deduced the laws of reflection & refraction and explained for the first time the formulation of Ultrasound machine based on Piezoelectric Phenomenon-transmission and reflection.

REFLECTION OF LIGHT

Imam Ahmad Raza has discussed about reflection of light, refraction & total internal reflection in his voluminous book, Fatawa Rizzawia vol.3rd Page No.240. He says,

"When the light hits the plane surface of a mirror, it bounces off at a regular angle. This is called regular reflection." We can show this by shining a thin beam of light onto a mirror and marking where its reflection lands.

This figure shows that the light hitting the mirror is called incident ray. The angle at which it hits the mirror is called the angle of incidence. The light leaving the mirror is called the reflected ray. The angle at which it leaves is called the angle of reflection. Imam Ahmad Raza says that,

"The angle of reflection is always equal to the angle of incidence at a plane surface." This is known as law of reflection of light.

REVERSAL OF IMAGE

Imam Ahmad Raza says,

"If you stand in front of the mirror, you can see an image of yourself. The image in the mirror looks the same size and shape as the object that is reflected. It is not exactly the same because right becomes left and left becomes right. The image is the same distance behind the mirror as the object is in front of the mirror" as shown in the figure.

Imam Ahmad Raza further writes on page240, about reflection of light that,

"The transparent small packed ice particles look shiny like sunlight due to this reflection. Also when the sunlight rays hit the water surface or mirror, the reflected

image observed is white brilliant." The reason is that the light from the flash unit enters the eye which is reflected back along its original path from the retina. This type of reflection back along the original direction is called retro reflection.

REFRACTION OF LIGHT

When the light ray moves from one medium to another medium, the incident ray is deflected from its original direction at the boundary between the media, the ray is said to undergo refraction. Refraction comes from the Latin for "broker", the same root occurs in the word "fracture". Refraction is the bending of light, depends on the material through which it is passing. The speed of light in a material can be described by its index of refraction, the ratio of the speed of light in empty space to its speed in the material.

Let the index of refraction of the medium with the incident ray be η_1, and that of the medium with the refracted ray be η_2, the angle that the incident and refracted rays make with the line normal to the boundary between the media are θ_1, and θ_2 respectively then:

$$\eta_1 \sin \theta_1 = \eta_2 \sin \theta_2$$

This is known as Snell's law founded by Willebrord Snell in1621 as shown in the figure.

The index of refraction of air is very close to unity, so the angle of the refracted ray θ_2 at the interface for light that passes from air into a medium with index of refraction η is given by: $\sin \theta_1 = \eta \sin \theta_2$

Because η is generally larger than one, it follows that $\theta_2 < \theta_1$ that is the light is bent toward the normal to the boundary surface we can say that when light enters a medium with a lower index of refraction such as when a ray of light travels from water to air, the ray is bent farther away from the line normal to the boundary.

Refraction is responsible for some curious optical effects. For example, foreshortening of an object in water is a familiar phenomenon.

ENERGY IN REFLECTION & REFRACTION

Refraction is generally accompanied by reflection. The incident ray carries electromagnetic energy proportional to the square of the incident electric field. At the boundary between media, this energy is divided into energy that is refracted and energy that is reflected, such that total energy is conserved. It follows from electromagnetic theory that when light is perpendicularly incident on a surface that separates a medium

of index of refraction η_1, from a medium of index of refraction η_2, the intensity of the reflected light, Ir is related to the incident Io by:

$$= \frac{Ir}{Io} \quad \frac{(\eta_2 - \eta_1)^2}{(\eta_2 + \eta_1)}$$

Only 4% of the incident light is reflected. The research study tells us that the intensity of reflected light varies with the angle of incidence.

TOTAL INTERNAL REFLECTION

About one century ago, Imam Ahmad Raza, has discussed total internal reflection in Fatawa Rizawia P/No. 240 volume No. 3rd by giving an example of Mirage and proved it by Geometric Optics with well defined diagrammatic representation as the modern Physics now says "total internal reflection can only when light travels from a medium, with a larger index of refraction towards a medium with a smaller index of refraction such as when light passes from denser medium to a rarer medium (e.g. water to air medium)."

We can understand this Phenomenon by simple geometry. Consider a light ray incident from a medium with an index of refraction η, to a medium with an index of refraction η_2, as shown in the figure, which explains the rays from a point source in glass falling on a glass-air interface. As the angle of incidence θ is increased, we reach a situation at which the refracted ray points along the surface, the angle of refraction being 90^0 for angles of incidence larger than this critical angle θ, there is no refracted ray, we speak of total internal reflection we find the critical angle by putting $\theta_2 = 90^0$ in the law of refraction:

$$\eta_1 \sin \theta c = \eta_2 \sin 90^0$$
$$\sin \theta c = \eta_2/ \eta_1 \text{ or}$$
$$\theta c = \sin^{-1} \eta_2/ \eta_1$$

The sin of an angle cannot exceed unity so that we must have $\eta_2 < \eta_1$. This tells us that total internal reflection cannot occur when the incident light is the medium of lower index of refraction. The word total means just that the reflection occurs with no loss of intensity. But in ordinary reflection from a mirror, there is an intensity loss of about 4%.

Imam Ahmad Raza has discussed total internal reflection with an example of mirage in Fatawa Rizzvia Vol. No.3rd P/No.240.

A mirage can be observed when the ground is so hot that the air directly above it is warmer than the air at higher elevations. The desert is, of course, a region in which such circumstances prevail, but Mirages are also seen on heated roadways during the summer. According to Imam Ahmad Raza research, the layers of air at different heights above the earth have different densities and different refractive indices. In this situation, the observer sees a tree in two different ways. One group of light rays reaches the observer by the straight line path A, and the eye traces these rays back to see the tree in normal fashion. The second group of rays travel along the curved path B. These rays directed toward the ground and are then bent as a result of refraction. As a consequence the observer also sees an inverted image of the tree. Imam Ahmad Raza says, that light from the sky refracts near surface of hot sand and giving the impression that there is a bright surface that would be interpreted as water-a mirage. The air near the surface of hot sand is hotter than the surrounding air as discussed by Imam Ahmad Raza one century ago.

Why Diamond Sparkle Brilliantly?

The answer is total internal reflection, we explain that where medium 2 is air, the critical angle is small for substances with large indices of refraction such as diamond, where

$$\eta = 2.42 \ \&$$
$$\theta c = 24.0^0$$

by comparison, for crown glass,

$$\eta = 1.52 \ \&$$
$$\theta c = 41.0^0$$

This property combined with proper faceting causes diamonds to sparkle brilliantly.

Application of total Internal Reflection-----Fiber Optics

The application of total internal reflection in our daily life is the use of solid glass or transparent Plastic rods to 'pipe' light from one place to another. As indicated in the fig-a., given below, this shows that light is confined to traveling within the rods, even around gentle curves, as a result of successive internal reflections such a light pipe can be flexible if these fibers are used rather than thick rods. If bundle of parallel fibers is used to construct an optical transmission line, images can be transferred one point to another.

■ Fiber Optics is used in the industries.

- Fiber Optics is used in medical diagnosis and surgery.

- Fiber Optics is used in Telecommunications. The fibers can carry much higher volumes of telephone calls and other forms of communication than electrical wires because of higher frequency of light.

Medical application of Fiber Optics is gaining popularity because fiber-optic devices are particularly useful for viewing images produced at inaccessible locations i.e. internal body sites. Physicians often use fiber-optic cables to aid in the diagnosis and correction of certain medical problems without the intrusion of major surgery. For example, a fiber optic cable can be threaded through the esophagus and into the stomach to look for ulcers. In a similar fashion, the cables can be used to examine the colon (intestines) or to do repair work without the need for large incisions.

Arthroscopic surgery-In surgical application, damaged knees and joints can sometimes be repaired using a process called arthroscopic surgery. In this technique, a small incision is made into the joint. Repair is accomplished by inserting a small fiber-optic cable through the cut to provide illumination and then trimming cartilage or damaged tissue with a small knife at the end of a second cable.

Mechanism: As fiber optics represents one of the most important technological applications of total internal reflection, the principle behind this technique of conducting light from one place to another is as follows:

A transparent Plastic fiber will serve as a conductor of light if any ray inside the fiber undergoes total internal reflection upon striking the side of the fiber. Fibers with diameters in the range of 50 μm (roughly the diameter of human hair) are frequently used. The figure a page 80 shows a ray in air ($\eta = 1$) entering a cylinder of diameter D at an angle θ with the axis of the cylinder. If η_f is the index of refraction of the fiber, then the angle that the ray makes with the axis inside the fiber is θ_f where $\sin \theta_f = \sin \theta_i / \eta_f$. This ray will strike the wall if the cylinder at an angle ($90^0 - \theta_f$) with the normal to the wall. There will be total internal reflection (which has been discussed by Alahazrat Imam Ahmad Raza Khan Bareilvi round about one century ago).

If $\quad \eta_f \quad \sin(90^0 - \theta_f) > 1 \quad$ that is,

If $\quad \eta_f \quad \cos\theta > 1 \quad\quad$ we have

$$\eta_f \ \cos\theta = \eta_f \ \sqrt{1\text{-}\sin^2 \theta_f}$$

$$= \ = \eta_f \ \sqrt{1\text{-}\sin^2\theta_1 / \ \eta^2_f} \ = \ \sqrt{\eta^2_f - \sin^2 \ \theta > 1}$$

Because $\sin^2 \theta_i \leq 1$,

we have

$$\sqrt{\eta^2_f - \sin^2 \theta_i} \geq \sqrt{\eta^2_f - 1}$$

thus we automatically satisfy the condition for total internal reflection,

$\eta_f \cos \theta_f > 1$, if $\sqrt{\eta^2_f - 1} > 1$

because the largest value of $\sin \theta_i$ is 1 (the light first enters the cylinder from the end), the above equation is a condition for internal reflection for all the light that enters the fiber.

Note: (that once a ray is in the fiber, it remains inside even if the fiber curves).

ATMOSPHERIC REFRACTION

One century ago, Imam Ahmad Raza was asked a question by Dr. Sir Zia-ud-din Vice Chancellor Aligarh University,

■ "What is the reason that the light appears before the sun rises and the light remains even the sun has fallen below the horizon?"

Imam Ahmad Raza, a creative scientific theologian of the 20th century, explained in detail practically and satisfied Dr. Sir Zia-ud-din by performing an experiment. Dr. Zia-ud-din was astonished and acknowledged in the word's that "Imam Ahmad Raza deserves for the title of noble prize, because Imam Ahmad Raza solved the complicated problem of Mathematics also."

Here, I mention the answer of Imam Ahmad Raza along with the experiment, known as refraction of light (atmospheric refraction), now the modern Physics strongly favours it.

When the rays of light from the sun strike the earth's atmosphere and are bent as they pass into a medium that has an index of refraction different from that of the almost empty space in which they have been travelling. This is because the light moves through layers of air that have a continuously changing index of refraction. When the rays reach the observer, the eye follows them back along the direction from which they appear to have come. The end result is that the sun is seen to be above the horizon even after it has fallen below it or the light appears before the sun rises as shown in the figure on page 82.

EXPERIMENT

(done by Imam Ahmad Raza).

Tape a coin to the bottom of a large container. Look at the coin from the side and move backwards until you can no longer see the coin. Remain still at that position, and have a friend   pour water into the bowel until it is full. Note that you are able to see the coin because the light is refracted at the water-air interface.

Technology often drives our ability to understand nature, because it gives us new tools and instruments that allow us to explore domains previously inaccessible. Astronomy and much of the physics owe their progress to the invention of the telescope. Modern biology could not have been created without the micro scope. We discuss here the principles that govern the construction of optical instruments. Their functioning is based on two very simple laws.

- Law of reflection of light

- Law of refraction of light

The law of reflection of light helps us to understand the images that we see in mirrors and explains the functioning of instruments such as reflecting telescope.

The law of refraction i.e. snell's law, applied to the light when passed through curved boundaries between refracting surfaces, explains the functioning of the eye, cameras, magnifying glasses and microscopes. Because these two laws can be applied simply by tracing the geometric paths of light rays, this aspect of the study of light is known as geometric optics.

It is a new horizon that Imam Ahmad Raza Khan is the first Muslim theologian of the world who offered formulation of ultrasound machine based on reflection and refraction of light in his book.

"As-sum-sam-ala-Mushaquq-fe-Aia-ulum-il-Arham 1896"

This is now known as Piezo electric phenomenon – transmission and reflection.

MODERN DESCRIPTION

The simplest reflecting surface is a flat (or plane) mirror when we look at ourselves in a mirror, we see our image. The question arises, what is this image and how is it formed? Imam Ahmad Raza has discussed in detail this image formation in his books.

- Fatawa Rizzawia – 3rd volume (new edition).

- Fatawa Rizzawia – 26th volume (treatise As-sum-sam 1896).

The modern physics explains that consider a point source of light in front of a plane mirror as shown in the figure page 79.

This diagrammatic representation shows that several rays of light emitted by a point source (s) and reflected off a plane mirror according the law that angle of incidence and angle of reflection are always equal, called the law of reflection of light which has been discussed by Imam Ahmad Raza in his book, Fatawa Rizzawia 3rd volume Page No. 240.

Simple geometry allows us to see that all the reflected rays trace back to the same point as shown in the figure page 84, in which:

■ Rays 1 and 3 have been shown

■ Equal angle of incidence and reflection Q_1 and Q_3 for these rays have been shown as well as the angles $\propto_1$ & $\propto_3$.

■ The angle formed by BP_1I is then equal to $\propto_1$.

■ If point B is formed by dropping a perpendicular to the mirror from point S and if I lies along the continuation of this line, triangle B_1P_1 and BSP_1 are similar triangles.

■ By the same method, so are triangles BIP_3 and BSP_3.

■ Because both rays 1 and 3 emanate from the same point S, the distance BS forms the base of both triangles to the left of the mirror (the object side), and the distance B1 forms the base of both triangles to the right of the mirror (the image side).

■ The figure shows that the (imaginary) continuations of rays 1 and 3 to the image side meet at point I, as would the continuation of any reflected rays.

■ An image point is in fact any point other than the object from which an unlimited number of rays emanate or appear to emanate when the rays are extended back in straight lines.

We have in fact calculated the location of point I. Because BIP_1, and BSP_1 are similar triangles, the distances BS and BI are equal. How does the eye / brain know where to put I? Two eyes (or one eye that moves a little) sense a bundle of rays as in figure-f, rather than single ray. The eye / brain can measure their degree of divergence and is capable of extrapolating this diverging bundle back to point I.

Hence, we conclude that the image formed by an object placed in front of a flat mirror as the object is in front of the mirror which has been discussed by Imam Ahmad Raza in his book Fatawa Rizzawia 3rd volume (P/240). Geometry also shows that the object height, h, equals the image height, h′. Lateral magnification, M is defined as follows:

$$M = \frac{image\ height}{object\ height} = \frac{h'}{h}$$

This is a general definition of the lateral magnification of any type of mirror. For a flat mirror, M = 1 because h′ = h. the observer sees that the image formed by a flat mirror has right left reversal.

In summary, the image formed by a flat mirror has the following properties.

■ The image is as far behind the mirror as the object is in front.

■ The image is un-magnified, virtual and upright. This has been discussed by Imam Ahmad Raza one century ago.

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   By: Imam Ahmad Raza

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   By: Imam Ahmad Raza

IMAM AHAMD RAZA & OTOLOGY (AUDITORY THEORY)

In the largest sense, Otology means knowledge of the ear, refers not only to the medical science but also to Philosophy, Anatomy, Physiology, teaching and research involved in the study of the ear.

The graphic model of the auditory system, called the auditory train of structures, is a schematic portrayal of the various anatomic components of the auditory pathway.

HISTORY OF OTOLOGY

To ancient times, the auditory system was emperic, based on conjecture and tempered by experience. The transition from the conjectural and empiric to the scientific proved to be slow and agonizing. Progress depended on investigation and elucidation of each sequential section of the auditory system. Indeed, the history of Otology is the history of discovery of the elements of the auditory system, its working, and its therapeutic manipulations.

Only with the rise of experimental science, the anatomical investigations provided new insights into the structure of auditory system with attendant shift in the logic that governed the explanation of auditory phenomena and clinical problems. This phase

applies mainly to the current century whose progress was measured in generations and is now measurable in decades.

Consequently, there was a wonderful progress in the last three millennia moved gradually from a purely speculative and empiric base to the domain of formal science.

Here, I just mention the name of scientific theologians / otologists along with their period of contribution regarding auditory system i.e. sense of hearing.

THE MILLENNIUM PHASE 500 BC TO AD1500

- Plato
- Aristotle   (384 Bc to 322 Bc)
- Hippocratus   (400 Bc to 377 Bc)
- Rufus   (AD 97)
- Galen   (AD 130 to AD 200)
- Lucretius   (99 Bc to 55 Bc)
- Alexander of Tralles   (AD 525 to AD 650)
- The century Phase   (1500 to 1850)
- Nikolaus Steno   (1638 to 1682)
- Santorini   (1681 to 1737)
- Vesalius   (1564)
- Valsalva   (1666)
- Fallopio   (1523 to1562)
- Cusseriol   (1561 to 1666)
- Duverny   (1648 -1730)
- Cotugno   (1736 - 1822)
- Scarpa   (1747 - 1832)
- Brechet   (1784 - 1845)
- Rosenthal   (1780 - 1829)
- Huschke   (1757 - 1850)
- Corti   (1822 - 1876)

Corti in 1850 crowned the period of intense investigation with the discovery of the organ of hearing --- organ of Corti. (Wurzburg University Published in 1851).

- Fabrizio   (1537 - 1719)

- Ingrassia (1510 - 1580)
- Capivacci
- Willis (1622 - 1675)
- Schelhammer (1649 - 1772)
- Koyter (1534 - 1600)
- Morgagni (1682 - 1762)
- Guy de Chailliac (1363)
- Archolano (1494)
- Guyot (1721)
- Turnbull (1839)
- Petil
- Cooper (1800)
- Richerad (1800)
- John Curtis (1816)
- **The generation phase** (1850 - 1950)
- Itard (1821)
- Alfonso Corti (1850)
- Theodore Bilrith
- Wilde (1853)
- Rinne (1855)
- Toynbee (1860)
- Meniere (1861)
- Siegle (1864)
- Politzer (1865)
- Knapp (1871)
- Hotz (1880)
- Helmholtz (1869)

Helmholtz furthered understanding of the physiology of hearing with his theory of Cochlear resonance, placing low frequency sensitivity in the apex, and high frequency in the base.

- Schwabach (1885)

- Polansky   (1842)
- Galton
- Wolf
- Poltilini   (1867)
- Gratenigo   (1904)
- Alahazrat Imam Ahmad Raza Khan Bareilvi

                                                    (1851- 1921)

- Holmgred   (1923)
- Portmann   (1926)
- Bell   (1877)
- Fletcher   (1923)
- Fleming   (1929)
- Wever and Bray   (1930)

THE DECADE PHASE (1940-1990)

- Hallpike and Cairns   (1938)
- Lempert   (1938)
- Florey   (1941)
- Wullstein and Zollner   (1952)
- Rosen   (1953)
- Shea   (1956)
- Von Bekesy   (1957)

Bekesy was awarded noble prize for his discovery of the travelling wave mechanism for the stimulation of the cochlea.

- Metz   (1946)
- Armstrong   (1954)
- Zwislocki   (1962)
- Kimura   (1967)
- Schukmecht   (1969)
- Jewett   (1971)
- Gacek   (1974)

The goal of this chapter is for the reader to gain some insight into the physical processes involved in the production, propagation and perception of the acoustic events - sense of hearing. The sense of hearing is based on the auditory system's ability to detect vibratory energy in the environment. The human auditory system's response to mechanical radiation spans 20 to 20,000Hz range.

The research study tells us that the source (our hand in this case) can controle wave amplitude, wave frequency and wave shape but not the wave speed. The speed is determined by the physical properties of the medium air / water. For example, if the hose is stretched tightly the wave speed increases. If the hose is made heavier by filling it with water, the wave speed lessens. Also the researchers claim that the properties of tension and weight apparently controle wave speed. The conclusion is that source movement determines wave shape while the medium determines wave speed. This can be shown mathematically by one – dimensional wave equation, written as,

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{C^2} \, x \, \frac{\partial^2 y}{\partial x^2}$$

Here C is the speed with which wave moves.

In case of the hose (wire, string etc) wave speed (c is found to be the following.

$$C = \sqrt{\frac{T}{P_1}}$$

T represents tension and P_1 represents linear density. Increased tension results wave speed while increased density slow wave speed.

The wave shape can be discussed mathematically by Fourier analysis. Fourier discovered that any wave shape can be "constructed" by the simultaneous addition of selected sine wave (or cosines) that differ in amplitude, frequency, and phase. For example, following equation approximates a square wave.

SOUND CAPTURE IN THE EXTERNAL EAR

The researchers claim that sound wave approaches the ear by diffraction, reflection, and resonance as they relate to the specialized environment of the external ear. Regarding hearing, each makes its own special contribution to the ears ability to detect sound in the environment.

HEAD DIFFRACTION

It refers to the wave ability to envelop the head with sound. This ability is clearly important because of the location of the ears and they are mounted on the sides of the head. The research study shows that low frequency (long wave length) sound can envelop a relatively small object without significant phase shifts and resultant pressure loss simple calculations can be used to estimate whether a particular frequency of sound will readily envelop the head and reach both ears with similar strength. For low frequency wave range that governs vowel sounds such as 125Hz, the wavelength can be computed as follows:

$$\lambda = \frac{c}{f} = \frac{1100\, ft/\sec}{125\, cyc/\sec} = 8.8\, feet/cycle$$

K, the wave number, can be calculated in the following manner.

$$K = \frac{1}{\lambda} = \frac{1}{8.8\, ft/cycle} = 0.11\, waves/ft$$

If head diameter is estimated at 10 inches or about 0.88ft, the following can be calculated:

KA = (0.11 wave / ft) (.88ft diameter)

= 0.1 wave

These calculations show that it takes 1/10th of the sound wave wavelength to fully envelop the head.

For high frequency sound of 8000 Hz, the frequency involved in the formation of consonant sounds, the following calculations are made:

Wavelength λ =   c / f

$$= \frac{1100\, ft/\sec}{8000\, cyc/\sec}$$

=   0.138 feet

=   1.5 inches

It is important to note that head orientation is also important in the reception of consonants (high frequency sounds).

AURICULAR REFLECTION

The human ears are equipped with auricles that protrude from the sides of the head and preferentially collect sound that emanates from the direction being faced.

The auricles acts as a reflecting surface in the immediate vicinity of the canal meatus cupping a hand behind the auricle, thereby enlarging the reflecting surface. For the ear to have parabolic reflection, the concha would have to be parabolic in shape.

CANAL RESONANCE

After entering the auricle sound wave encounters the external auditory canal when sound reaches the depths of the canal, it is confronted by an obstacle the eardrum (tympanic membrane). As it strikes the drum, part of its energy is absorbed as it ricochets back toward the meatus. As it again approaches the outside world after reflecting off the eardrum, if encounters the transition from plane wave to three dimensional wave as it exits the canal.

The change in impedance feels like a wall because the laterally dispersed oscillating molecules just beyond the mouth of the canal returns energy to the molecules in the mouth of the canal at an odd angle. Consequently a ripple is sent back down the canal toward the eardrum.

If the canal is a certain length i.e. one quarter of the wavelength involved, then a remarkable effect occurs. The reflections at closed and open ends of the tube become mutually reinforcing and the phenomenon of resonance occurs which has been discussed by Imam Ahmad Raza one century ago in his book Al-Kashf-i-Shafia 1909.

For example, in an ear canal measuring 1 inch, the frequencies that are amplified most have wavelengths that are four times larger. Therefore the wavelength is 4 inches or 1/3 foot. This can be written as,

$$f = c / \lambda$$

$$= \frac{1000 \, ft / \sec}{33 \, ft / wave}$$

$$= 3300 \text{ waves / sec or Hz.}$$

It concludes that, a 1 inch long ear canal is driven into a resonant state by a sound with a frequency of 3300 Hz.

COMBINED EFFECTS

The external ear, because it is mounted on the side of the head, experiences the combined effects of head diffraction, auricles reflection and canal resonance.

The research experiments show that diffraction around the head permits reception of low frequency sounds even when one ear does not directly face the sound source; the auricular reflections add about 5 to 10 db to the audio frequencies when the head is rotated 45°, permitting the ear to "face" the sound source, and canal resonance gives a big boost of about 15 dB in the 3-4 KHz range. These combined effects result in an overall pressure increase at the tympanic membrane.

SOUND TRANSFORMATION IN THE MIDDLE EAR

The tympanic membrane: The eardrum or the tympanic membrane represents the first closing membrane of the embryo. It separates the external auditory canal from the middle ear cleft. The tympanic membrane is very thin and light ballooned outward can be set in motion by a wide range of frequencies. It is pearly white in colour and oval or cone shaped. Its dimensions are 8mm x 9mm x 0.1mm. It is placed obliquely in a such a way that it makes an angle of 45° with the floor of the external auditory canal.

The part of the tympanic membrane which is situated above the two mallear folds is flaccid called pars flaccida also known as shrapnell's membrane. The rest of the tympanic membrane is tense, called pars tensa. There is a bright conical area, artefact running forward from the tip of the handle of the malleas called "Con Of Light".

The tympanic membrane (ear drum) is made up of three layers as:

- Outer   --   Epidermal layer
- Middle   --   Fibrous layer (absent in pars Flaccida)
- Inner   --   Mucous layer

Attached to the very centre (indented) of the tympanic membrane is the handle of the malleus. At its other end, the malleus is tightly bound to the incus by ligaments so that whenever the malleus moves, the incus moves with it. The opposite end of the incus in turn articulates with the stem of the stapes and the face plate of the stapes lies against the membranous labyrinth in the opening of the oval window where sound waves are conducted into the inner ear, the cochlea.

The precision studies of tympanic membrane motion that used laser holography revealed that the actual motion of the drum involves two separate zones of motion, one in front and one behind the malleus handle. The tympanic membrane is normally ballooned outward and indented centrally where it is attached to the malleus. It is maintained normally in a tense state poised to detect pressure changes so minute that

the amplitude of the vibration is measured on an atomic scale. In fact, at the human threshold for sound at 1000Hz, this amplitude is about one billionth of a centimeter.

This amount is less than the diameter of a hydrogen atom. Moreover, the outward stance of the tense tympanic membrane makes it more favourable to detect outward motion, in effect, suggesting that we here primarily during the rarefaction rather than the compression phase of the wave.

The research study tells us that tympanic membrane acts as a "go between" transforming molecular wave motion in the air of the canal into vibrations of the ossicles. This "go between" function of the tympanic membrane is termed impedance matching. In essence, this function facilitates the transfer of energy from one vibrating system to another.

In short, the normal tympanic membrane is an effective impedance matching device. It is capable of responding to some vibrations that are no bigger than the diameter of an atom and of transmitting such motion to the ossicular system.

The tympanic membrane and ossicles comprise a lever system that transforms air pressure waves in the ear canal to fluid waves within the cochlea. The research study shows that without such a device, 99% of the sound wave energy would be reflected.

SOUND TRANSDUCTION IN THE INNER EAR

Sound wave is introduced into the inner ear fluids like a sonar pulse by the vibration of the stapes footplate. Then it stimulates the organ of corti-organ of hearing and initiates train of electric events in the central nervous system that result in hearing. The process that converts the mechanical signal to an electrical one is called transduction.

MECRO-MECHANICS OF THE ORGAN OF CORTI

The macro-mechanical motion of the entire organ of corti results in an up and down displacement of two basilar membrane via the traveling wave. The upward movement of the organ of corti results in a shearing tug that bends these hair. This bending of sensory hair leads to electrical activation of the cell and initiation of neural impulses that then travel via the auditory nerve into the Brain.

ANATOMY OF THE EAR

The human ear is divided into three portions:

■ External ear

■ Middle ear

- Inner ear

EXTERNAL EAR

It consists of:

- Auricle (Pinna) or ear flap

- External auditory canal (external acoustic meatus)

MIDDLE EAR

It consists of:

- Air

- Muscles

  i)   Tensor tympani

  ii)   Stapedius

- Bones

  i)   Malleus

  ii)   Incus

  iii)   Stapes

The middle ear is like a match box with six sides.

- Roof

- Floor

- Anterior wall

- Posterior wall

- Medial wall

- Lateral wall

The lateral wall of middle ear is partly membranous and partly bony. The membranous part is tympanic membrane while bony part is the outer attic wall.

INTERNAL EAR

It consists of:

- Cochlea

- Vestibule

- Sem-circular canals

Cochlea consists of two parts:

- Modiolus

- Cochlear canal: It consists of

    i)   Upper – scala vestibuli

    ii)   Middle – scala media-organ of corti

    iii)   Lower – scala tympani

PHYSIOLOGY OF HEARING

The human ear has two main functions:

- Hearing

- Equilibrium

In this article we are only concerned with hearing. To under stand the mechanism of hearing, we discuss in detail.

- history of auditory system

- theories of hearing

- detail function of each part of ear

The hearing mechanism consists of two components:

- Conductive mechanism of hearing – consists of external ear & middle ear.

- Perception mechanism of hearing (sensorineural) - made up of cochlea, cochlear nerve, its nuclei and their central connections.

The auricle collects sound waves and transmits them through the auditory canal

$(S-shape, 2\frac{1}{2}\,cm\ in\ length)$ to the tympanic membrane.

The middle ear (tympanic cavity) is the tiny cavity in the temporal bone. Within it are the three auditory ossicles.

- Malleus

- Incus

- Stapes

and two small muscles:

- The stapedius and

- Tensor tympani are also found in the middle ear. The stapedius muscle is attached to the stapes and the tensor tympani muscle to the handle of the malleus.
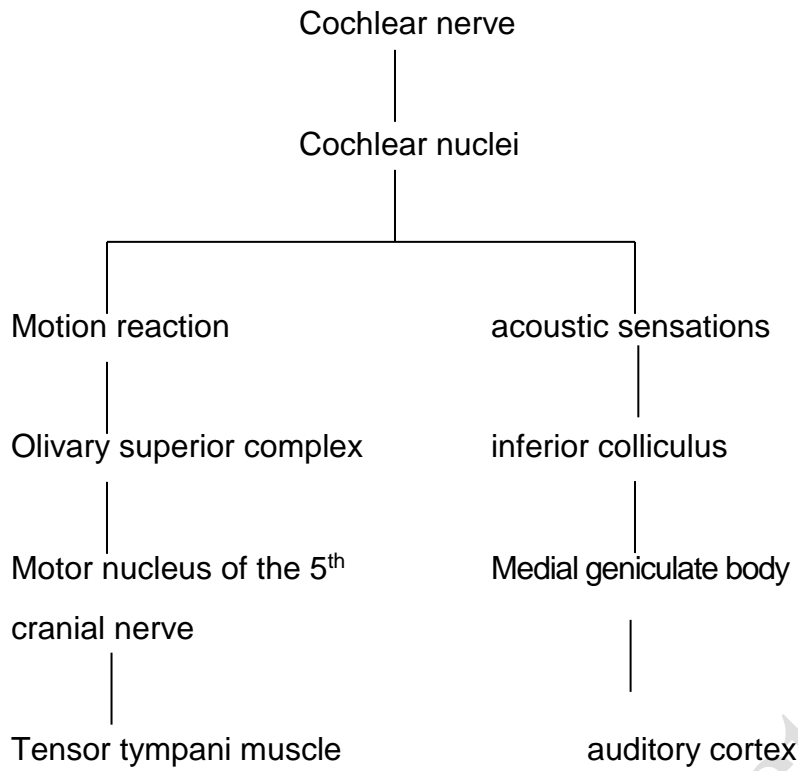
The middle ear has five openings-the opening covered by the tympanic membrane, the opening of the auditory or Eustachian tube which connects the middle ear with the nasopharynx and through which outside air can enter; the opening into the mastoid cavity; the opening into the inner ear (round & oval windows). Four functions are ascribed to the middle ear.

■ To transmit energy from sound vibrations in the air column of external acoustic meatus across the middle ear into the fluid contained within the cochlea.

■ To reduce the amplitude of vibrations accompanying loud sounds of low frequency.

■ To equalize air pressure on both sides of the tympanic membrane via the auditory canal to prevent the membrane from rupturing.

■ The basic function of the middle ear muscles (the stapedius and the tensor tympani) is to protect the cochlea from damage by loud sound. As these muscles have a latent period of reflex contraction, they do not protect the cochlea from sudden sharp or explosive sounds. Another function of tensor tympani and stapedius muscles is to decrease a person's hearing sensitivity to his or her own speeds.

The inner ear, the cochlea is embedded in a bony cavity in the temporal bone of the skull called bony labyrinth. Vibrations of the entire skull can cause fluid vibrations in the cochlea itself. On the surface of the basilar membrane lies a structure, the organ of corti which contains a series of electromechanically sensitive cells, the hair cells. This results in the generation of receptor potentials (e.g. cochlea microphonics and nerve impulses (action potential) which are carried to the central connections. This cochlear path can be shows as:

Organ of corti

|

Spiral ganglion

|

Cochlear nerve

|

Cochlear nuclei

Motion reaction   acoustic sensations

Olivary superior complex   inferior colliculus

Motor nucleus of the 5th   Medial geniculate body
cranial nerve

Tensor tympani muscle   auditory cortex

THEORIES OF HEARING

There are a number of theories that account for certain aspects of hearing named as:

- Place theory   Von Helmholtz

  (1821-1894)

  German Scientist

- Traveling wave theory   (Von Bekesy, 1957)

- Frequency theory

- Volley theory

- Rizivi theory   Imam Ahmad Raza

  (1856-1921)

PLACE THEORY

Von Helmholtz (western physiologist) developed a theory of hearing called the place theory. Von Helmholtz (1867) discussed the mechanism of hearing with example of Piano. According to his theory, the outer ear collects the air, sends it into the auditory canal. When these waves strike the eardrum, vibrations occur and sound is heard. He suggested that the basilar membrane resonates and produces vibrations such as the strings of a piano or a harp do – high tones at the smaller narrower end and low tones at the wider end. Nerve fibers along the basilar membrane transmit impulses that correspond to the vibrations. In other words, according to the place theory, the nerve fibers of the basilar membrane transmit a replica of a sound to the brain. In short, place theory claims that the sensation of pitch is determined by the place on the basilar membrane that is stimulated.

TRAVELING THEORY

Von Bekesy (1957) developed the concept of traveling wave theory. According to this theory, a sound wave traveling through the cochlear fluid displaces, or moves, the basilar membrane at a location that is sensitive to the frequency of sound wave. The theory is adequate to account for the sensation of all but low – frequency sounds. It has been suggested that the neural centres for low frequencies are probably outside of the basilar membrane (Plomp, 1975).

FREQUENCY THEORY

The frequency theory holds that the basilar membrane vibrates at the same frequency as the original sound stimulus and consequently, stimulates the auditory nerve fiber at the same frequency as the original stimulus. The difficulty with the frequency theory is that the nerve fibers cannot fire at the same rate as the frequency of most sound waves.

THE VOLLEY THEORY

According to the volley theory, the auditory nerves fire in alternating groups that work in combination. Because the groups alternate with each other, no one group is overworked. One group is activated by a particular frequency and then rests as another group is activated. After a sufficient refractory period, the first group is activated again. As a result of this co-ordination, auditory impulses are transmitted by many groups of nerve cells.

Sound can travel in any medium through air, water, metal, or the ground. The sound that we hear comes to us like light, in the forms of waves.

How do sound waves travel?

Sound waves are actually movements of the molecules in the medium. The motion of the sound source alternately pushes molecules together (compressing the air, marking it denser) and pulls them apart (rarefying the air, making it thinner), causing vibrations in the form of sound waves. When sound is generated by a loud speaker the air pressure goes up during compression and drops during rarefaction. Thus sound waves are actually changes in air pressure that moves at about 340 meters per second. The pattern of sound waves closely resemble the pattern of the ripples that spread out after you've tossed a pebble into a creek. Basically a similar process is taking place in both situations: waves of energy are passing through a medium, temporary displacing molecules. Sound needs a medium. In a vacuum, a ringing bell would be as silent as a scream in a nightmare.

Sound waves are repetitive changes in air pressure. The numbers of the cycles that occur in the wave each sound are measured in hertz (Hz) and human beings normally hear sound waves in the range between 20-20000 Hz. The higher the frequency, the higher the pitch of a sound and the Shiller it will sound. Most human speech is in a range between 100 and 3500 Hz.

According to the place theory, we hear a certain sound depending upon the particular spot on the basilar membrane that it stimulates.

According to the frequency theory, it is the rate with which the basilar membrane is stimulated that determines what we hear.

A variation of frequency theory is the volley principle which suggests that groups of nerve fibers form "squads" and that individual neurons take turns firing in volleys.

Scientists generally agree that place theory seems to explain how we hear high pitched sounds (above 3000 Hz) and that frequency theory explains our hearing of very low pitched sounds (below 50 Hz).

Hearing is a channel through which we can learn about and appreciate our world. Through hearing, we can understand speech – our chief medium for imparting and acquiring knowledge through hearing, we receive a great many signals and cues.

Through hearing we also derive one of our greatest pleasures (peace of mind) like Qirat, Naat and Salam.

THE PHYSICAL STIMULUS FOR HEARING

When an object vibrates, the molecules of the air around it are pushed together and thus are put under positive pressure. In turn, they push again the molecules close to them and these molecules transmit the pressure to neighboring molecules and this process is carried on. A wave of pressure moves through the air in much the same way that ripples move on the water. However sound-pressure waves travel much faster than do waves of water, at sea level and at a temperature of 20C°. They travel at about 760 miles per hour or approximately 1,130 feet per second.

The alternation in air pressure moving in all directions from the source are called sound waves and such sound waves are the physical stimuli for everything we hear.

The simple sound waves are sine waves because their shape can be expressed by the sine function of trigonometry.

But most of the sounds we hear in every day life are the result of complex waves. Complex waves can take many, many forms, but, in general, they are either periodic or aperiodic. This means that they either have a repetitive pattern occurring over and over again as they consist of wave with various amplitudes and frequencies occurring irregularly what we call "noise" is usually aperiodic in wave form, which Ala Hazrat has also discussed in his book Al-Kasf-I-shafia, 1909.

Periodic waves are composed of several sine waves that are multiples of each other. The lowest frequency in such waves is called the fundamental frequency, the highest multiples are called the harmonic frequencies.

STRUCTURE OF THE EAR & HEARING

The ear has three principal parts:

- External ear

- Middle ear

- Inner (internal) ear

The external ear collects the energy, the middle ear transmits the energy and the inner ear, where the transduction of energy into nerve impulses actually occurs. The pinna of the external ear collects energy which travels through the auditory canal (small

air filled duct) to the eardrum / tympanic membrane. The tympanic membrane is a thin membrane stretched tightly across the inner end of the canal.

Alternations in the pressure of sound wave move this small membrane back and forth. The oscillation of the eardrum, in turn, moves three small bones, the ossicles, so that vibration is conducted through the middle ear to the entrance of the cochlea in the inner ear. Hence energy is transmitted mechanically, and amplification takes place through the middle ear. When changes in air pressure moves the ossicles back and forth, waves are set up in the fluid that fills the canals of the cochlea. The waves in the cochlea reach the organ of corti which lies on the basilar membrane (fibrous membrane). The organ of corti contains a series of electromechanically sensitive cells, the hair cells. These are the receptive end – organs that generate nerve impulses in response to sound vibrations.

The nerve impulses initiated in the cochlea, travel along certain nerve fibers with the brain. These fibers and the nerve cells from which they originate, make up what is called auditory pathway (passage for hearing).

The renowned scientific theologians and scientists who elaborated hearing theories are as:

- Von Helmholtz 1821 – 1894 (German Science)

- Von Bekesy 1957

- Ala Hazrat Imam Ahmad Raza Khan Qadri Al-Barelvi 1856-1921.

    Place theory or resonance theory is the one widely accepted today. The astonishing point is that this theory was firstly offered by German scientist, Von Helmholtz in 1867 and later in 1909, Imam Ahmad Raza present this theory. We appreciate this creative work of Imam Ahmad Raza because of two reasons:

- He had no modern scientific education from any university.

- Also at that time, this theory was not introduced in educational institutes of the subcontinent. So we can say that this was the creative work of Imam

Ahmad Raza. According to latest research, he has full command on more hundred faculties of knowledge. So, in the present century he has surpassed the contemporaries (i.e. Eastern as well, as the Western scientific theologians of the world).

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IMAM AHMAD RAZA & ATOMIC THEORY

Once it became known that the atom has a nucleus that contains all the positive charges and almost all the atomic mass, the structure and properties of the nucleus itself became objects of study. Early on, many of the scientists involved in this research were convinced that nuclear physics would have no practical applications. But now the situation is quite different and the understanding of the properties of the nucleus has had enormous consequences for atomic technology and for society in general.

Atomic program is the current issue of this scientific era. Regarding nuclear system, we mention the two primary methods that are used to extract energy from the nucleus and convert it to useful purposes. For example, the energy released in radioactive

decay has been used to provide electric power to cardiac pacemakers and to space probes.

In nuclear fission, a heavy nucleus is split into two fragments. In nuclear fusion, two light nuclei are combined into a heavier nucleus.

Reactors based on nuclear fission today provide a significant share of the world's electric power. Research and engineering are actively under way to develop reactors based on nuclear fusion.

APPLICATIONS OF NUCLEAR PHYSICS

(Atomic Program)

The practical applications of nuclear physics are widespread and include;

- Power generation, radiometric dating, microscopic crack and void testing.

- Medical applications of radiations

- Radioactive tracers in medicine

- Radioactive tracers in agricultural research

- Computed axial tomography (CAT scans)

- Magnetic resonance imaging (MRI)

- And cancer treatment.

FAMOUS FIRSTS IN ATOMIC THEORY

First Period:

- Democritus   400 B.C.

- Lucritus   200 B.C.

Second Period:

- Jan Dalton   England   (1766-1844)

- J.J. Thomson   England   (1856-1940)

- Rutherford   New Zealand (1871-1937)

- Neil's Bohr   Danish   (1885-1962)

- Imam Ahmad Raza   Asia   (1856-1921)

Third Period: (Period of Radio activity)

- Prof. Henri Bechurel   French   (1885-1909)

- Prof. Enrico Fermi   Italy   (1901-1954)

- **■** Albert Einstein   Germany   (1879-1955)
- **■** Marie Curie   French   (1867-1934)
- **■** Perie Curie   French   (1859-1906)
- **■** Ottohan & Strassmann   (1939)

Amongst the above-mentioned renowned physicists, Imam Ahmad Raza is the first Muslim scientific theologian of the 20th century who offered the atomic theory from this verse of the Holy Quran:

- **■** And we broke then into pieces with full confusion (19:34)

Another verse of the Holy Quran, gives us clue to the nuclear Fission.

- **■** If you are reduced to minute particles, you will be created a new (7:34).

The atomic history shows that Ottohan and Strassmann in 1939, made an experiment, called nuclear fission and were awarded regarding atomic services as shown in the formula:

$$\longrightarrow {}^{235}_{92}U + {}^{1}_{0}n \qquad {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n + Energy$$

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IMAM AHMAD RAZA & MEDICAL PHYSIOLOGY

(GASTRO INTESTINA PHYSIOLOGY)

Physiology is a branch of Medical science, which deals with the physical and chemical factors that are responsible for the Origin, development, and progression of life. The field of physiology is extended as:

- Cellular physiology

- Bacterial physiology

- Viral physiology

- Plant physiology

- Human Physiology

Here, we are concerned with the human physiology, especially Gastrointestinal physiology so it is concerned with the specific characteristics and mechanisms of human body that make it a living being.

In his book "Maqmae Al-Hadeed" the eminent scholar, Imam Ahmad Raza has discussed Gastrointestinal Physiology covering the topics of: Ingestion of food.

Storage and digestive function of stomach.

Lubricating and protective properties of GIT.

Chyme

Digestive and absorptive function of small intestine.

Entero – Hepatic circulation.

Metabolic functions of the liver

Liver Blood flow

Portal Venous system

Formation of bile

Excretion of waste products

Thirst, sweating

Circulatory system (functional parts of circulation)

Arteries, arterioles, capillaries, venules, veins

Micro circulation, vasomotion

Homeo stasis

THE GASTROINTESTINAL PHYSIOLOGY

The gastrointestinal tract is a co-ordinate structure with the function of ingestion and absorbing nutrients and excreting unabsorbed and waste products.

To understand the mechanism of digestion, absorption and excretion, we must know the general principles of GIT functions:

■ Motility

■ Nervous controle and

■ Blood circulation

The gastro intestinal tract (alimentary canal) provides the body with a continual supply of water, electrolytes and nutrients as:

■ Movement of food through the alimentary canal.

■ Secretion of digestive juices and digestion of food.

■ Absorption of digestive products, water and various electrolytes.

■ Circulation of gastro intestinal organs to carry away the absorbed substances and.

■ Control of all these functions by nervous and hormonal system.

BRIEF ANATOMICAL PHYSIOLOGY OF GIT

The biological research tells us that the entire gastro intestinal tract has various functions:

- Esophagus is concerned with the simple passage of food.

- Stomach is concerned with the storage of food.

- Small intestine is concerned in the digestion and absorption of food.

The digestive and absorptive functions of the gastro intestinal system depend upon a variety of mechanisms that soften the food, propel it through the gastro intestinal tract, and mix it with bile from the gall bladder and digestive enzymes secreted by the salivary glands and pancreas. Some of these mechanisms depend upon intrinsic properties of the intestinal smooth muscle. Others involve the operation of visceral reflexes or the actions of gastro intestinal homones.

GASTRO INTESTINAL CIRCULATION

The blood vessels of G.1 system are part of a more extensive system called splanchnic circulation. It includes the blood flow through the alimentary canal itself-the blood flow through the spleen, pancreas and the liver, arranged in a series of parallel circuits with all the blood that goes through the gut, spleen and pancreas draining via the portal vein to the liver.

NEURONAL CONTROL OF GASTROINTESTINAL FUNCTION

The neurobiological study shows that the gastro intestinal tract has a nervous system all its own called the entire nervous system, beginning in the esophagus and extending all the way to the anus.

The entire gastrointestinal tract consists of two major networks of nerve fibers that are intrinsic to the GIT.

- The myenteric nerve plexus (Auerback's plexus-outer one, between the outer longitudinal and middle circular muscle layers. It controls the GIT movements.

- Sub-mucous plexus (meissner's plexus) inner one, between the middle circular layer and the mucosa. It controls GIT secretion and local blood flow.

The neurobiological studies show that there are about 1 million neurons in this GIT system which control GIT movements and secretions.

TYPES OF NEUROTRANSMITTERS SECRETED BY THE ENTERIC NEURONS

The experimental research studies show that the neurotransmitters secreted by the nerve endings of different types of enteric neurons, control various GIT functions.

- Acetylcholine

- Norephinephrine

- Adenosine triphosphate ATP

- Cholecystokinin

- Serotonin

- Dopamine

- Substance P

- Vasoactive intestinal polypeptide

- Somatostatin

- Leu – Encephalin

- Met – Encephalin

- Bombesin

   Note: Acetylcholine excites GIT activity while norephenephrine inhibits GIT activity.

INGESTION OF FOOD

The amount of food that a person ingests is determined principally by the intrinsic desire for food called hunger. Hunger means a craving for food with a number of objective sensations. The type of food that a person takes is determined by appetite. The term appetite usually implies desire for specific types of food instead of food in general.

In the mouth, food is mixed with saliva and propelled into the esophagus. Peristaltic waves in the esophagus move the food into the stomach.

FUNCTIONAL TYPES OF MOVEMENTS

Two basic types of movements occur in the gastro intestinal tract.

- Propulsive movements: which cause food to move forward along the tract for digestion and absorption.

- Mixing movements: which keep the intestinal contents thoroughly mixed all the times.

MECHANICAL ASPECTS OF FOOD INGESTION

There are two major mechanical aspects of food ingestion:

- Mastication (chewing)

- Swallowing (Deglutition)

1) <u>MASTICATION</u>

Mastication breaks up large food particles with the help of teeth and mixes the food with the secretions of salivary glands. This wetting and homogenizing action aids subsequent digestion. All the Jaw muscles work together, also help in chewing.

Chewing (mastication) helps in digestion of food because the digestive enzymes act only on the surfaces of food particles. Grinding the food to a very fine consistency prevents excoriation of GIT and increases the ease with which food is emptied from the stomach into the small intestine and thence into all succeeding segments of the gut.

In the salivary glands, there are secretary (zymogen) granules containing the salivary enzymes which are discharged from the acinar cells into the ducts. The biological research tells us that saliva contains two digestive enzymes:

■ Lingual lipase, secreted by the glands on the tongue and

■ Ptyalin (Salivery amylase)

Saliva also contains mucins, glyco-proteins that lubricate the food and protect the oral mucosa. Saliva also contains I_gA, the first immuno-logic defense against bacteria and viruses; lysozyme, which attacks the walls of bacteria; lactoferrin, which binds iron and is bacterio-static and proline rich proteins that protect tooth enamel and bind toxic tannins.

Saliva performs a number of important functions. It facilitates swallowing, keeps the mouth moist, it also serves as a solvent for the molecules that stimulates the taste buds, aids speech by facilitating movements of the lips and tongue and keeps the mouth and teeth clean. The salvia may also have antibacterial action.

CONTROL OF SALIVERY SECRETION & CHEWING REFLEX

■ Food in the mouth causes reflex secretions of saliva due to chewing reflex and so does stimulation of the vagal afferent fibers at the gastric end of the esophagus.

■ Chewing is controlled by nuclei in the brain stem.

■ Stimulation of reticular formation near brain stem centres for taste can cause continual rhythmic chewing movements.

■ Stimulation of area in the hypothalamus, amygdala and even in the cerebral cortex near the sensory area for taste and smell can cause chewing.

2- <u>SWALLOWING (DEGLUTITION)</u>

Swallowing is a complicated mechanism and a reflex response, triggered by afferent impulses in the trigeminal, glossopharygeal and vagus nerves. These impulses are integrated in the nucleus of the tractus solitarius and the nucleus ambiguous.

Swallowing process is divided into three stages.

■ Oropharangeal (voluantry) stage which initiates swallowing process.

■ Pharyngeal (involuantry) stage constitutes the passage of food through pharynx into the esophagus.

■ Esophageal (involuantry) stage promotes the passage of food from pharynx to the stomach.

Swallowing is initiated by the voluantry action of collection the oral contents on the tongue and propelling them backward into the pharynx.

As the bolus of food enters the pharynx, it stimulates swallowing receptor areas all round the opening of the pharynx, especially on the tonsillar pillars and impulses from these pass to the brain stem to initiate a wave of involuantry contraction in the pharyngeal musculature that pushes the material into the esophagus. Inhibition of respiration and glottic closure are part of the reflex response. The research study tells us that a normal adult swallows frequently while eating, but swallowing also continues between meals. The total number of swallows per day is about 600. 200 while eating and drinking, 350 while awaking without food, and 50 while sleeping.

OESOPHAGEAL STAGE OF SWALLOWING

The primary function of esophagus is to conduct food from the pharynx to the stomach with its movements as:

■ Primary peristaltic movement

■ Secondary peristaltic movement

Primary peristalsis is simply continuation of the peristaltic wave that begins in the pharynx and speeds into the esophagus during the pharyngeal stage of swallowing. This wave passes all the way from the pharynx to the stomach in approximately 8-10 seconds. If the primary peristaltic wave fails in its function, esophagus distends, with the result secondary peristaltic wave starts due to this retained food until and unless the food has emptied into the stomach.

NERVOUS CONTROL OF SECONDARY PERISTALTIC WAVE.

It is initiated by intrinsic neural circuits in the esopharyngeal entire nervous system and partly by the reflexes that are transmitted through vagul afferent fibers from the esophagus to the medulla oblongata and then back again to the esophagus through vagul efferent fibers.

STOMACH

Stomach is the very important part of GIT having following functions:

MOTOR FUNCTIONS OF THE STOMACH

The motor functions of the stomach are threefold:

■ Storage function i.e. storage of large quantities of food until it can be accommodated in the duodenum.

■ Mixing of this food with gastric secretions until it forms a semi fluid mixture called chyme, and

■ Slow emptying of the food from the stomach into the small intestine at a rate suitable for proper digestion and absorption by the small intestine which has been discussed by Imam Ahmad Raza one century ago in his book Maqam-i-ul-Hadid 1886.

■ The Hcl Kills many of the ingested bacteria.

■ Intrinsic factor, a substance necessary for the absorption of cyanocobalmim (VIT B12) from the small intestine.

ANATOMICAL CONSIDERATIONS

Regarding physiological anatomy, the stomach can be divided into two major parts.

■ Corpus or body of stomach

■ Antrum

Fundus located at the upper end of the body of the stomach, functions mainly as a part of the body.

The gastric mucosa contains many deep glands. In the pyloric and cardiac regions, the gland secrete mucus. In the body of the stomach, including the fundus, the glands contain.

■ Parietal (oxyntic) cells, which secrete Hcl and intrinsic factor and:

■ Chief (zymogen, peptic) cells which secrete pepsinogens. These secretions mix with the mucus secreted by the cells in the necks of the glands Mucus is also secreted

along with HCO_3^- ions by mucus cells on the surface of the epithelium between glands. Several of the glands open on a common chamber (gastric pit) that opens in turn on the surface of the mucosa.

■ Blood supply & nerve supply of the stomach.

The stomach has a very rich blood and lymphatic supply. Its parasympathetic nerve supply comes from vagi and its sympathetic supply from the celiac plexus.

STORAGE FUNCTION OF THE STOMACH

As food enters the stomach, it forms concentric circles in the body and fundus of the stomach, the newest food lying closest to the esophageal opening and the oldest food lying nearest the wall of the stomach. Normally, when food enters the stomach, a vagul reflex greatly reduces the tone in the muscular wall of the body of the stomach so that the wall can bulge progressively outward, accommodating maximum quantity of food upto a limit of about 1.5 litres.

MIXING AND PROPULSION OF FOOD IN THE STOMACH

The basic electrical rhythm of the stomach. The biological research study tells us that the digestive juices of the stomach are secreted by the gastric glands which cover almost the entire wall of body of the stomach except along a strip on the lesser curvature of the stomach. These secretions come immediately into contact with that portion of the stored food lying against the mucosal surface of the stomach. When the stomach is filled, weak peristaltic constrictor waves, also called mixing waves, move towards the antrum along the stomach wall approximately once every 20 seconds.

These waves are initiated by the basic electrical rhythm consisting of electrical "slow waves" that occur spontaneously in the stomach wall. As the slow waves move down the stomach, they not only cause the secretions to mix with the outer portions of the stored food but also provide weak propulsion to move the food toward the antrum. It has been observed that when stomach is full, these mixing contractions usually begin near the mid point of the stomach; but as the stomach empties, the contractions become stronger and also originate farther back up the stomach wall, thus propelling the last vestiges of stored food into in stomach antrum then when completely empty, the stomach becomes mainly quiescent until new food enters.

CHYME

After the food has become mixed with the stomach contractions, the resulting mixture that passes down the gut is called chyme. The degree of fluidity of chyme depends on.

- Relative amount of food

- Stomach secretions and

- On the degree of digestion that has occurred

The appearance of chyme is like murky, milky, and semi fluid or paste.

HUNGER CONTRACTIONS

It has been observed that when food is present in the stomach, peristaltic contractions take place. And when stomach has been empty for a long time, hunger contractions occur. When hunger contractions occur in the stomach, the person sometimes experiences a sensation of pain in the pit of the stomach, called hunger pangs. Hunger pangs do not begin until 12-24 hours after the last ingestion of food.

GASTRIC MOTILITY & EMPTYING

When food enters the stomach, the organ relaxes by the reflex process of receptive relaxation. This relaxation of the gastric musculature is triggered by the movement of the pharynx and esophagus. It is followed by peristaltic contractions that mix the food and squirt it into the duodenum at a controlled rate. Thus the intensity of this antral peristalsis is the principal factor that determines the rate of stomach emptying.

When pyloric tone is normal, each strong antral peristaltic wave forces several millilitres of chyme into the duodenum. Thus the peristaltic wave provides a pumping action that is frequently called the "pyloric pump".

ROLE OF THE PYLORUS IN CONTROLLING STOMACH EMPTYING

The distal end of the stomach is the pylorus. Here the thickness of the circular muscle becomes 50-100% greater than in the earlier portion of the stomach antrum. It also remains slightly tonically contracted almost all the time. Therefore, the pyloric circular muscle is frequently called the pyloric sphincter. The biological research study tells that gastric emptying is normal if the pylorus is held open large enough for water and other fluids normally to empty from the stomach with ease. The antrum, pylorus and upper duodenum apparently function as a unit. Contraction of the antrum is followed by sequential contraction of the pyloric region and the duodenum. Normally, regurgitation

from the duodenum does not occur because the contraction of the pyloric segment tends to persist slightly longer than that of the duodenum. The prevention of regurgitation may also be due to the stimulation action of CCK and secretin on the pyloric sphincter.

REGULATION OF GASTRIC MOTILITY & EMPTYING

The rate at which the stomach empties into the duodenum is regulated by signals both from the stomach and the duodenum. The research study tells us that the stomach signals are as:

■ Nervous signals caused by distention of the stomach by food and.

■ Hormonal signals-the hormone gastrin released from the antral mucosa in response to the presence of certain types of food in the stomach.

The biological research tells us that food rich in carbohydrate leaves the stomach in a few hours. Food rich in protein leaves more slowly and emptying is slowest after a meal containing fat. The rate of emptying also depends on the osmotic pressure of the material entering the duodenum.

Both these signals mainly increase pyloric pumping force and at the same time slightly inhibit the pylorus, thus promoting stomach emptying.

SUMMARY OF CONTROLE OF STOMACH EMPTYING

Emptying of the stomach is controlled by the following factors.

■ Stomach factors

■ Feedback signals

■ The stomach factors are:

■ Degree of filling of the stomach

■ Excitatory effect of Gastrin on antral peristalsis.

The feedback signals from the duodenum are:

★ Enterogastric feedback reflexes

★ Hormonal feed back reflexes.

It has been observed that the two feedback inhibitory mechanisms work together to slow the rate of emptying when too much chyme is already in the small intestine or the chyme is excessively acid, containing too much unprocessed protein or fat, is hypotonic

or hypertonic or is irritating. In this way the rate of stomach emptying is limited to that amount of chyme that the small intestine can process.

DIGESTION IN THE STOMACH

The important function of the stomach is storage of food, but digestion of food also takes place like CHOs, proteins and fats.

DIGESTION OF CARBOHYDRATES IN THE STOMACH

When food is chewed, it is mixed with the saliva which contains the enzyme ptyalin (amylase) secreted mainly by the parotid glands. This enzyme hydrolyzes starch into the disaccharide maltose and other small polymers of glucose containing 3-9 glucose molecules.

It has been observed that the food remains in the mouth only a short time. The digestion, however, continues in the body and fundus of the stomach for as long as an hour until food is mixed with the stomach secretions. Before the food becomes completely mixed with the gastric secretion 30% - 40% of the starches will have been hydrolyzed mainly to maltose.

DIGESTION OF PROTEINS IN THE STOMACH

The dietary proteins are formed of long chains of amino acids bound together by peptide linkages. The biological studies tell us that pepsin, has a digestive action on proteins at PH: 2-3. It is essential that stomach juices must be acidic for this enzymatic action.

The enzyme, pepsin, digest collagen (a major constituent of the inter-cellular connective tissue of meats) and begins the process of protein digestion. This splitting of protein is a process of hydrolysis occurring at the peptide linkages between amino acids.

DIGESTION OF FATS IN THE STOMACH

The dietary fats are mostly neutral fats called triglycerides, each molecule of which is composed of a glycerol nucleus and three fatty acids. In the routine diet, are also small quantities of phospholipids, cholesterol, and cholesterol esters containing fatty acids. It has been observed that a very small amount of short chain triglycerides of butterfat origin is digested in the stomach by gastric lipase. All fat digestion occurs in the small intestine.

THIRST

Imam Ahmad Raza States in his book, Maqam-i-ul Hadid 1886 that thirst is the primary regulator of intake of water. It is defined as "conscious desire for water". A thirsty person receives relief from thirst immediately after drinking water. The phenomenon of thirst is important for regulating body water, osmolality and sodium (Na⁺) concentration as in the osmoreceptor renal mechanism.

THIRST CENTER IN BRAIN

According to modern biological research the thirst center lies along the anteroventral wall of the 3rd ventricle that promotes antidiuresis, can also cause thirst. Also located anterolaterally in the pre-optic hypothalamus, are the small areas that when stimulated electrically will cause immediate onset of drinking that continues as long as stimulation lasts called the thirst center. The neurocells function as osmoreceptors to activate the thirst mechanism. Additionally, an increase in osmotic pressure of the cerebrospinal fluid in the 3rd ventricle has essentially the same effect to promote drinking.

BASIC STIMULUS FOR EXCITING THIRST

Intracellular Dehydration. It has been observed that any factor will cause intracellular dehydration until causes thirst. The most common cause of this is increased osmolar concentration of the extracellular fluid especially increased sodium (Na⁺) concentration, which carry osmosis of the fluid from the neurnal cells of the thirst center.

SECRETARY FUNCTION OF GIT

The biological research studies tell us that throughout the gastrointestinal tract, the secretary glands subserve two primary functions.

- First, digestive enzymes are secreted in most areas from mouth to the distal end of the ileum.

- Second, mucous glands (from mucous to the anus) provide mucus for lubrication and protection of all parts of GIT.

The renowned Muslim theologian, Imam Ahmad Raza, in his book "Maqam-e-ul-Hadid 1886" page no. 16 writes that:

''پھر اس کے غلیظ (Thick) کو رقیق (thin) لزج (Viscous / Glutinous)

کو منزلق (Lubricate) کرتا ہے''۔

This discussion relates to the secretory functions of the GIT especially lubricant and protective properties. This can be discussed in the light of modern biological research as;

MODERN RESEARCH

Regarding secretion and lubrication, several types of glands provide different types of secretions in the GIT.

- Mucus cell glands

- Salivary glands

- Tubular glands

- Crept of lieberkuhn.

BASIC MECHANISMS OF STIMULATION

OF GIT GLANDS

There are three basic mechanisms of stimulation of GIT glands:

- Effect of local contact and enteric nervous stimuli.

- Autonomic stimulation of secretion.

  i- Para sympathetic stimulation

  ii- Sympathetic stimulation

- Regulation of glandular secretion by hormones.

- Effect of local contact and enteric nervous stimuli.

The mechanical presence of food in a particular segment of GIT and its adjacent regions usually causes to secrete moderate to profound quantities of digestive juices which are helpful for proper digestion and absorption. These secretions take place by local contact with food and by the activation of nervous control of the GIT. The types of stimuli which are responsible for the secretion are:

  i- Tactile stimulation

  ii- Chemical irritation

  iii- Distension of the gut wall

AUTONOMIC STIMULATION OF SECRETION

Para Sympathetic Nervous Stimulation. The neurobiological research tells that stimulation of Para sympathetic nerves to the GIT (especially upper portion) increases the rate of glandular secretion-including the salivary glands, esophageal glands, gastric

glands, pancreas and Bruner's glands in the duodenum and also of the glands of the distal portion of the large intestine.

SYMPATHETIC NERVOUS STIMULATION

It has been observed that sympathetic stimulation has a dual effect.

- First, it slightly accelerates the secretion by the respective glands,

- Second, sympathetic stimulation causes constriction of the blood vessels, with the result it reduces the copious secretions caused by para sympathetic or hormonal stimulation.

REGULATION OF GLANDULAR SECRETION BY HORMONES

The experimental study explains that in stomach and intestine several different GIT hormones help in regulating the volume and character of the secretion. The mechanism is that these hormones are liberated from the GIT mucosa in response to the presence of food in the lumen of the gut. They are then absorbed into the blood and carried to the glands where they stimulate secretion. This type of stimulation is valuable in increasing the output of gastric juice and pancreatic juice when food enters the stomach or duodenum. Also the hormonal stimulation of the gall bladder wall causes it to empty its stored bile into the duodenum.

(Note the GIT hormones are polypeptides or polypeptide derivates).

LUBRICATING & PROTECTIVE PROPERTIES OF THE GIT

(Mucus & its importance)

Mucus is a thick secretion having good lubricating and protective properties. Mucus is mainly composed of:

- Water

- Electrolytes

- And a mixture of several glyco-proteins.

Mucus is different in different parts of the GIT but everywhere it has several important characteristics that make it both an excellent lubricant and protectant for gut wall. The important characteristics of mucus are as follow:

- Mucus has adherent qualities that makes it adhere tightly to the food or other particles and also to spread as a thin film over the surface.

■ Regarding protective function, mucus has sufficient body that it coats the wall of the gut and prevents actual contact of food particles with the mucosa.

■ Mucus has a low resistance for slippage so that the particles can slide along the epithelium easily.

■ Mucus causes fecal particles to adhere to each other to form the fecal masses that are expelled during fecal movement.

■ Mucus is strongly resistant to digestion by the gastrointestinal enzymes.

■ The glyco-proteins of the mucus have amphoteric properties i.e. they are capable of buffering small amounts of either acids or alkalies. Mucus often contains moderate quantities of bicarbonate HCO_3^- ions, which specifically neutralize acids.

In short, mucus has the excellent lubricating and protective properties i.e. it has the ability to allow easy slippage of food along GIT and also to prevent excoriation or chemical damage to the epithelium. It is interesting to note this property of mucus has been discussed one century ago by Ala Hazrat Imam Ahmad Raza Khan in his book Maqam-i-ul-Hadid 1886.

SECRETION OF SALVIA

According to Imam Ahmad Raza's research, saliva which contains mucus, moistens and lubricate the food particles before swallowing. Saliva, secreted by the three pairs of salivary glands located in the head, drains into the mouth through a short series of ducts. The principal glands of salivation are:

■ Parotid glands (serous secretion)

■ Submandibular and sublingual glands both mucus serous secretion.

■ Also, small buccal glands (secrete mucus)

The biological research tells us that the normal daily secretion of saliva ranges between 800-1500 ml in response to certain stimuli, usually mechanical, or chemical or olfactory. The histological studies tell us that all the salivary glands are compound tubulo- alveolar glands consisting of true glandular tissue and connective tissue framework.

FUNCTIONS OF SALIVA

Saliva Contains Two Major Types Of Protein Secretion.

- ■ **A Serous Secretion** that contains the enzyme amylase (ptyalin) which practically digests starches and lingual lipase secreted by the glands on the tongue.

- ■ **Mucus secretion** that contains mucus which moistens and lubricates the food particles before swallowing.

- ■ Another function of salvia is to dissolve some of the food molecules and protect the oral mucosa.

- ■ Function of saliva for oral Hygiene-the biological studies tell us that mucus type of saliva is secreted all the time except during sleep (very little secretion) which plays an important role in maintaining healthy oral tissues.

Note the saliva has a PH between 6.00-7.4 for digestive action of amylase (ptyalin) the secretion of saliva is controlled by both sympathetic and parasympathetic innervation.

ESOPHAGEAL SECRETION

The esophagus contains two types of glands named:

- ■ Simple mucus glands in the main body of esophagus.

- ■ Compound mucous glands mainly in the gastric end of the esophagus.

The biological studies tell us that the esophageal secretions are entirely mucus in character and principally provide lubrication for swallowing and protect the esophageal wall by excoriation.

GASTRIC SECRETION

The stomach is a saclike organ located between the esophagus and the small intestine. Its functions are to store, dissolve, and partially digest food, and to deliver its contents to the small intestine in amounts optimal for digestion and absorption.

The digestive action of the stomach reduces food particles to a solution, known as chyme, which contains molecular segments of proteins and polysaccharides and droplets of fat. None of these digestion products can cross the epithelium of the gastric wall, and thus little absorption of organic nutrients occur in the stomach which has been discussed by Imam Ahmad Raza the renowned scientific theologian of the 20th century, in his book Maqam-i-ul-Hadid 1886.

MODERN EXPLANATION

The electron micropic (E/M) studies tell us that the stomach wall consists of the following layers:

- Serous coat

- Muscle coat

- Sub-mucous coat

- Mucous coat

In addition to the mucus secreting cells that line the entire surface of the stomach, the stomach mucosa consists of gastric glands which are of three chief kinds, named as:

- Cardiac glands

- Fundic glands

- pyloric glands

CARDIAC GLANDS

Cardiac glands are found only close to the esophageal junction. These glands are simple tubes or branch like structure and mucous secreting in character.

FUNDIC GLANDS

These glands are found throughout the mucosa of the fundus and the body of the stomach consisting of following types of cells:

- Chief (peptic or zymogenic) cells

- Oxyntic (parietal) cells

- Mucoid cells (mucous neck cells)

- Argentaffen cells (in small numbers) at the base of the glands.

PYLORIC GLANDS

These glands are found in the pyloric region of the gland. They are coiled and branched in structure. The cells are of one kind only and similar to the mucous cells of the fundic glands.

Regarding secretion; the oxyntic glands secrete HCL, pepsinogen, intrinsic factor and mucus.

The pyloric glands secrete mainly mucus for protection of the pyloric mucosa, some pepsinogen and very important, the hormone, GASTRIN, which plays a key role in controlling gastric secretion.

The mucus neck cells secrete mainly mucus but also some pepsinogen.

The chief (peptic) cells secrete large quantities of pepsinogen.

The study with E/m shows that in addition to its digestive activities, the mucosa of the stomach is important as the site for the synthesis and secretion of intrinsic factor which mediates the absorption from the food of vitamin B_{12} (cyanocobalamin), lack of which results in megaloblastic amaemia.

It has been observed that small quantities of other enzymes are also secreted in the stomach juices like:

- Gastric lipase
- Gastric amylase and
- Gelatinase

REGULATION OF GASTRIC SECRETION

By nervous and hormonal mechanism-basic factors that stimulate gastric secretion: Acetylcholine, gastrin and histamine.

The neurobiological research studies tell us that the basic neurotransmitters that directly stimulate secretion by the gastric glands are acetylcholine, gastrin, and histamine.

Mechanism: All of these function by binding first with receptors on the secretary cells. Then the receptors activate the secretary processes. Acetylcholine has an excitatory action i.e. excites secretion by all the secretary cell types in gastric glands, including secretion cell types in gastric glands, including secretion of pepsinogen by the peptic cells, hydrochloric acid (HCL) by the parietal cells, mucus by the mucus cells and gastrin by the gastrin cells. But, both the gastrin and histamine stimulate very strongly the secretion of acid by the parietal cells.

A few other substances also stimulate the gastric secretary cells such as:

- Circulatory amino acids
- Caffeine.

STIMULATION OF ACID (HCL) SECRETION

The glands lining the stomach's wall secrete a strong acid, hydrochloric acid (Hcl). The biological research study tells us that the stomach secretes about 2 litres of hydrochloric acid / day. The concentration of hydrogen ions in the stomach's lumen may reach 150mM, 3 million times greater than the concentration in the blood.

NERVOUS STIMULATION OF ACID SECRETION

About half of the nerve signals to the stomach that cause gastric secretion originate in the dorsal motor nuclei of the vagi and pass via the vagus nerves first to the enteric nervous system of the stomach wall and then to the gastric glands. The other half of the secretary signals are generated by local reflexes that occur entirely within the enteric nervous system itself. The neurobiological research tells us that all the secretary nerves release the neurotransmitter, acetylcholine, at their endings on the glandular cells. Nerve stimulation of gastric secretion can be initiated either in the brain, especially in the limbic system, or in stomach itself. The stomach – initiated signals can activate two different types of reflexes.

■ Long reflexes

■ Short reflexes

The long reflexes are transmitted from the stomach mucosa all the way to the brain stem and then back to the stomach through the vagus nerves. The short reflexes originate locally and are transmitted entirely through the local enteric system.

The types of stimuli that can initiate the reflexes are:

■ distension of the stomach wall by the luminal contents.

■ Chyme osmolality (total solute concentration)

■ Chyme acidity

■ Chyme concentration of specific digestion products – monosuccharides, fatty acids, peptides and amino acids (chemical stimuli). These stimuli act on the receptors located in the wall of the tract mechanore ceptor, osmoreceptors, and chemoreceptors-to trigger reflexes that influence the effectors-the muscle layers in the wall of the tract and the exocrine glands that secrete substances into its lumen.

GASTRO INTESTINAL HORMONES

The radio immune assay study tells us that the gastro intestinal hormones play an important role in the regulation of gastrointestinal secretion and motility. These hormones are:

■ Gastrin family the primary members are-gastrin and cholecystokinin (CCK)

■ The secretin family, the primary members of which are – secretin, glucagon, glicentin (GLI), VIP, and gastric inhibitory peptide (GIP).

Other gastro intestinal hormones are:

- Motilin, somatostatin, glucagon

- Caerulein

- Glucose – dependent insulinotropic peptide (GIP)[3].

PHASES OF GASTRIC SECRETION

The neuronal and hormonal control of the gastro intestinal system especially gastric secretion is, in large part, divisible into three separate phases, cephalic, gastric, and intestinal – according to stimulus location. It is interesting to note that the Muslim theologian, Imam Ahmad Raza has discussed these phases of GIT system in his book Maqam-i-ul-Hadid is 1886.

THE CEPHALIC PHASE

The cephalic phase is initiated when receptors in the head (cephalic, head) are stimulated by sight, smell, taste, and chewing the food. It is also initiated by various emotional states, the greater the appetite, the more intense is the stimulation. Neurogenic signals causing the cephalic phase of secretion can originate in the cerebral cortex, or in the appetite centres of the amygdala or hypothalamus. They are transmitted through the dorsal motor nuclei of the vagus to the stomach. That is the efferent pathways for the reflexes are parasympathetic and sympathetic fibers. These fibers activate neurons in the gastrointestinal nerve plexuses, which in turn affect sensory and contractile activity.

THE GASTRIC PHASE OF REGULATION

It has been observed that the three stimuli in the stomach initiate the reflexes – distension, decreased acidity, and peptides formed during the digestion of ingested protein. The responses to these stimuli are mediated by short and long neural vasovagal reflexes and by release of the hormone gastrin.

THE INTESTINAL PHASE

The presence of food in the upper portion of small intestine, particularly in the duodenum, can cause the stomach to secrete small amounts of gastric juice and also small amounts of gastrin released by duodenal mucosa. The intestinal phase of regulation is initiated by stimuli in the intestinal tract-distension, increased acidity, osmolarity and various digestive products. It is mediated by both short and long neural reflexes and by GIT hormones (secretin, CCK, GIP).

Imam Ahmad Raza says;

<div dir="rtl">''پھر ثفلِ کیلوس کوامعا کیطرف پھینکتا ہے''۔</div>

EXPLANATION

It means that chyme is then entered into the small intestine. The research study tells us that after chyme enters the small intestine, pancreatic secretion becomes copious, most in response to the hormone, secretin. Moreover, cholecystokinin causes still much more increase in the secretion of enzymes.

Also, it has been observed that as the chyme enters the intestine from the stomach and causes initial distension of the proximal intestine, the elicited peristaltic waves begin immediately to spread the chyme along the intestine, and this process intensifies as additional chyme enters the duodenum. The peristaltic activity of the small intestine is greatly increased by:

- Beginning entry of the chyme into the   duodenum.

- By the gastro enteric reflex which is initiated by the distension of the stomach. This has been discussed by Imam Ahmad Raza one century ago in his book Maqam-e-ul-Hadid 1886. It has been observed that nervous and several hormonal factors also affect peristalsis. These hormones are as:

- Gastrin

- Cholecystokinin

- Insulin and

- Secretin

PANCREATIC SECRETION

According to Imam Ahmad Raza's research, as food (chyme) enters the small intestine, process of digestion takes place. According to Guyton's physiology, pancreatic Juice is secreted most abundantly 1500ml in response to presence of chyme in the upper portion of small intestine. The modern biological research now tells us that the exocrine portion of the pancrease secretes HCO_3^- ions and a number of digestive enzymes into duct that converge into the pancreatic duct, the latter joining the common bile duct from the liver just before entering the duodenum. The enzymes are secreted by the gland cells at the pancreatic end of the duct system, whereas bicarbonate ions HCO_3^- are secreted by the epithelial cells lining the early portions of the duct system itself. It has been observed that hydrogen ions are actively transported out of the duct cells and

released into the blood while bicarbonate ions are secreted into the duct lumen. The enzymes secreted by the pancreas, follow activation, digest fat, polysaccharides, proteins, nucleic acids to fatty acids, sugars, amino acids and nucleotides respectively. The pancreatic secretion is controlled in part by a reflex mechanism and in part by the gastrointestinal hormones secretin and CCK. The pancreatic enzymes are given as:

Trypsin, chymotrypsin, elastase, carboxy peptidase, lipase, amylase, ribonuclease, deoxy ribo-nuclease.

REGULATION OF SECRETION OF PANCREATIC JUICE

Secretion of pancreatic juice is primarily under hormonal controle. Secretin acts on the pancreatic ducts to cause copious secretion of a very alkaline pancreatic juice that is rich in HCO_3 ions and poor in enzymes. Secretin also stimulates bile secretion. Chole cystokinin acts on the acinar cells to cause release of zymogen granules and production of pancreatic juice rich in enzymes.

LEVER & BILIARY SYSTEM

Regarding liver and Biliary system Imam Ahmad Raza states.

پھر ماسار یقا کی راہ سے خالص کو جگر میں لے جاتا ہے وہاں کیموس دیتا ہے۔

صفحہ 16 مقا مع الحدید

EXPLANATION

In this discussion, Imam Ahmad Raza has explained the following topic.

- Entero – Hepatic circulation
- Liver blood flow
- Portal venous system,
- Formation of bile
- Excretion of waste products
- Metabolic function of the liver

MODERN MEDICAL RESEARCH

Modern concept of gross hepato biliary anatomy tells us that liver is the largest gland in the body. It weighs approximately 1500gm in the adult. The liver accounts for 2% of the body weight of adult and about 5% of the body weight of a newborn. The liver lies in

the right upper quadrant of the abdomen, beneath the diaphragm and connected to the digestive tract by means of the portal vein and the biliary drainage system.

The anatomy of the biliary tract is that the right and left hepatic ducts emerge from the liver and unite in the portal hepatis to form the common hepatic duct. This is soon joined by the cystic duct from the gall bladder to form the common bile duct. The common bile duct runs between the layers of the lesser momentum of the liver, lying anterior to the portal vein and to the right of the hepatic artery. Passing behind the first part of the duodenum in a groove on the head of the pancreas, it enters the second part of the duodenum. The duct runs obliquely through the posteriomedial wall, usually joining the main pancreatic duct to form the ampulla of vater (1720). The ampulla makes the mucus membrane bulge inward to form an eminence, the duodenal papillae.

The duodenal portion of the common bile duct is surrounded by a thickening of both longitudinal muscle fibers derived from the intestine. This is called sphincter of oddi (1887).

The studies of Rappaport have suggested the concept of the liver acinus (based upon the earlier work of Mall) that may be defined as the mass of liver tissue which is supplied by a terminal branch of the portal vein and hepatic artery and drained by a terminal branch of the bile duct, this has also been discussed by Ala Hazrat Imam Ahmad Raza Khan in his book, Maqam-i-ul-Hadid 1886.

PRINCIPLE FUNCTIONS OF THE LIVER

The basic principal functions of the liver are:

- Formation of bile
- Carbohydrate storage and release
- Formation of urea
- Cholesterol metabolism
- Manufacture of plasma proteins
- Metabolism of fat
- Inactivation of some polypeptide hormones
- Reduction and conjugation of adrenocortical and gonadal steroid hormones.
- Synthesis of 25 hydroxy cholecalciferal
- Detoxificaiton of many drugs and toxins.

The biological research tells us that bile is secreted by the cells of the liver into the bile duct, which drains into the duodenum. Between meals, the duodenal orifice of this duct is closed and the bile flows into the gall bladder, where it is stored. As food enters the mouth, the sphincter around the orifice relaxes, and when the gastric contents enter the duodenum, the hormone cholecystokinin from the intestinal mucosa causes gall bladder to contract to secrete bile.

COMPOSITION OF BILE

The composition of bile is as follows:

- Water   97.5 gm/dl
- Bile salts   1.1 gm / dl
- Bile pigments   0.2%
- Cholesterol   0.1 gm / dl
- Fatty acids   0.12 gm / dl
- Lecithin   0.04 gm / dl
- Fat   0%
- Alkaline phosphatase are
- Inorganic salts   0.7%
  - Na+   145 meq / litre
  - K+   5 meq / litre
  - Ca+   5 meq / litre
  - Cl -   100 meq / litre
  - HCO_3^- 28 meq / litre

BILE SECRETION-ENTEROHEPATIC CIRCULATION

Bile is secreted by cells in the liver into a number of small ducts, the bile canaliculi which converge to form the common hepatic duct. The bile ingredients (bile salts, cholesterol, lecithin) are synthesized in the liver and help solubilized fat in the small intestine. Bicarbonate ions neutralize acid in the duodenum and the bile pigments are extracted from the blood by the liver and excreted via the bile.

From the standpoint of gastrointestinal function, the most important components of bile are the bile salts. During the digestion of a fatty meal, most of the bile salts entering the intestinal tract via the bile are absorbed in the ileum (the last segment of the small intestine) by an active transport process and returned via the portal vein to the liver and back to the intestine via the bile duct is known as entero hepatic circulation which has been discussed by Imam Ahmad Raza in his book Maqam-e-ul-Hadid 1886. However, a small amount of the bile salts are not recycled, but are lost in the feces. The liver synthesizes new bile salts from cholesterol to replace them.

In addition to synthesizing bile salts from cholesterol, the liver also secretes cholesterol into the bile. (this process, followed by excretion of cholesterol in the feces, is one of the mechanism by which cholesterol homeostasis is maintained).

The research study tells us that the quantity of the bile secreted by the liver each day is highly dependent on the availability of bile salts-the greater the quantity of bile salts in the entero hepatic circulation, the greater the rate of bile secretion.

THE BILE SALTS AND THEIR FUNCTION

The liver cells form about 0.5 gram of bile salts daily. The precursor of the bile salts is cholesterol, which is either supplied in the diet or synthesized in the liver cells during the course of fat metabolism and then converted to cholic acid or chenodeoxy - cholic acid in about equal quantities. These acids then combine with glycine and to a lesser extent with taurine to form glyco-and tauro-conjugated bile acids. The salts of these acids are secreted in the bile.

Regarding fat digestion and absorption the bile salts have two important functions in the intestinal tract. First, they have a detergent action on the fat particles in the food, which decreases the surface tension of the particles and breaks the fat globules into minute sizes. This is known as emulsifying or detergent function of the bile salts. Secondly, the bile salts help in the absorption of fatty acids, mono-glycerides cholesterol, and other lipids from the intestinal tract.

EXCRETORY FUNCTION OF BILE

Also, bile serves as a mean for excretion of several important waste products from the blood. These include especially bilirubin (an end products of hemoglobin destruction) and excess of cholesterol synthesized by the liver.

BLOOD FLOW THROUGH THE LIVER

The biological research tells us that about 1100mm of blood flows from the portal vein into the liver sinusoids each minute. Also round about 350mm of blood flows into the sinusoids from the hepatic artery. The total blood flow averaging about 1450 ml / min. This amounts to about 29% of the resting cardiac output.

MEASUREMENT OF LIVER BLOOD FLOW

Total hepatic blood flow per minute can be measured by a modified tick procedure. The liver blood flow is then calculated by the usual Fick formula as follow.

$$\text{Hepatic blood flow ml / min} = \frac{\text{rate of dye excretion (mg / min)}}{A-v \; difference \; in \; dye (mg / ml)}$$

METABOLIC FUNCTIONS OF THE LIVER

The basic functions of the liver can be divided into:

■ Its vascular function for storage and filtration of blood.

■ Its metabolic functions concerned with the majority of the metabolic systems of the body.

■ Its secretary and excretory functions that are responsible for forming the bile that flows through the bile ducts into the gastrointestinal tract.

As Ala Hazrat Imam Ahmad Raza Khan has discussed metabolic functions of the liver, so these functions are briefly discussed here: The liver cells all together are a large chemically reactant pool, having a very high rate of metabolism, sharing substrates and energy from one metabolic system to another, processing and synthesizing multiple substances that are transported to other areas of the body and performing a myriads of other metabolic functions. In short, metabolic functions of liver are summarized as:

    ★   Carbohydrate metabolism

    ★   Fat metabolism

    ★   Protein metabolism

CARBOHYDRATE METABOLISM

■ Storage of glycogen

■ Conversation of galactose and sucrose to glucose

■ Gluconeogensis – for maintaining normal blood glucose concentration.

■ Formation of many important chemical compounds.

- Storage of vitamin.

- Storage of Iron.

FAT METABOLISM

Special functions of liver in fat metabolism are:

- Very high rate of oxidation of fatty acids to supply energy to other bodily functions.

- Formation of lipoproteins

- Synthesis of large quantities of cholesterol and phospholids.

- Conversion of large quantities of carbohydrates and proteins to fats.

PROTEIN METABOLISM

The most important functions of liver in fat metabolism are:

- Deamination of amino acids.

- Formation of urea for removal of ammonia from the body fluids.

- Formation of plasma proteins.

- Inter conversions among the different amino acids and other compounds for metabolic process of the body.

FUNCTIONS OF INTESTINES (COLON)

The principal functions of the colon are;

- Absorption of water and electrolytes from the chyme.

- Storage of fecal matter until it can be expelled.

The biological research study tells us that located on the entire surface of the small intestine, are small pits known as crypts of lieberkuhn. The epithelial cells in these crypts secrete fluid what is called intestinal secretions at a rate of about 2000ml, pure extra cellular fluid, having alkaline PH in the range of 7.5 – 8.0 is reabsorbed by the villi throughout the length of small intestine.

This circulation of fluid from the crypts to the villi obviously supplies a watery vehicle for absorption of substances from the chyme as it comes in contact with the villi, which is one of the primary functions of the small intestine which has been discussed by the Imam Ahmad Raza as:

<div dir="rtl">

''پھر سہولت دفع کو پیاس دیا ہے پھر پانی پہنچاتا ہے''

بحوالہ مقامع الحدید ۱۶۔

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MECHANISM OF SECRETION OF THE WATERY FLUID

The mechanism of secretion of watery fluid is as follows:

- Active secretion of chloride (Cl^-) ions into the crypts and

- Active secretion of bicarbonate (HCO_3) ions.

The secretion of these ions, especially the chloride ions (Cl^-), causes electrical drag, sodium (Na^+) ions through the membrane as well. Finally all these ions together cause osmotic movement of water.

In the intestines, the intestinal contents are mixed with the secretions of the mucosal cells and with pancreatic juice and bile. The process of digestion which begins in the mouth and stomach, is completed in the lumen and mucosal cells of small intestine, and the products of digestion are absorbed along with most of the vitamin, and fluid. Also the hyper-tonicity of the chyme in the intestine causes the osmotic movement of water from the isotonic plasma into the intestinal lumen.

It has been observed that the most common motion of the small intestine during a meal is a stationary contraction and relaxation of intestinal segments, with little apparent net movement toward the large intestine. Each contracting segment is only a few centimeters long, and the contraction lasts a few seconds. The chyme in the lumen of a contracting segment is forced both up and down the intestine. This rhythmical contraction and relaxation of the intestine is known as segmentation which produces a continuous division and subdivision of the intestinal contents, thoroughly mixing the chyme in the lumen and bring it into contact with the intestinal wall.

It has been observed that the intensity of segmentation can be altered by:

- Hormones

- The enteric nervous system and the autonomic nervous system i.e. parasympathetic activity increases the force of contraction while sympathetic stimulation decreases it.

After most of a meal has been absorbed, the segmenting contractions cease and are replaced by a pattern of peristaltic activity known as the migrating motility complex.

It has been observed that the intestinal hormone, motilin is thought to initiate the migrating motility complex, while the pattern of contractile activity during segmentation and peristalsis is co-ordinated by the enteric nervous system.

Mild distension of the intestine produces a contraction of the smooth muscle on the oral side of the distension and relaxation of the smooth muscle on the anal side. This

pattern of activity is known as law of the intestine which is mediated by neurons in the myenteric plexus and promotes movements of the luminal contents towards the large intestine.

ENZYMES IN THE SMALL INTESTINE

The research study tells us that the epithelial cells of the mucosa continue secreting digestive enzymes that digest some food substances. These enzymes are:

Peptidases, sucrase, maltase, isomaltase and lactase, intestinal lipase.

SECRETION OF THE SMALL INTESTINAL

About one century ago, Imam Ahmad Raza has discussed the digestive and absorptive function of small intestine what the modern medical science now explains that in the duodenum there are small, coiled acinotubular compound mucous glands called Brunner's glands, mainly between the pylorus and the papilla of vater, where the pancreatic juice and bile empty into the duodenum. These glands secrete mucous which protect the duodenal wall from digestion by the gastric juice.

BASIC MECHANISM OF ABSORPTION

It has been observed that absorption of the gastro intestinal mucosa occurs by:

- Active transport and

- Diffusion

Active transport imparts energy to the substance as it is being transported for the purpose of concentrating it on the other side of the membrane or moving it against an electrical potential. Diffusion means transport of substances through the membrane as a result of molecular movement along an electro chemical gradient.

ABSORPTION IN THE SMALL INTESTINE

It has been experimentally observed that normal daily absorption of small intestine consists of several hundred grams of carbohydrates, 100 or more grams of fat, 50-100 grams of amino acids 50-100 grams of iron and 7-8 litres of water but it can be increased also while large intestine can absorb more water and ion.

LARGE INTESTINE (COLON)

The large intestine is a tube 2.5 inch in diameter and about 4 feet long. Its first portion is cecum, forms a blind ended pouch from which extends a small finger like projection, appendix (having no known function). The colon consists of three relatively straight segments ascending, transverse and descending portions. The terminal portion of the desending colon is S-shaped, forming the sigmoid colon, which empties into a relatively straight segment, the rectum which ends at the anus. The secretion of the colon is scanty, lack digestive enzymes and consists mostly of mucus. The primary function of the large intestine is to store and concentrate fecal material before defecation. It absorbs water, sodium (Na^+) and other minerals. By removal of about 90% of the fluid, it converts the 1000-2000 ml of isotonic chyme that enters it each day from the ileum to about 200-250 ml of semisolid feces.

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IMAM AHMAD RAZA & HOMEOSTASIS

Homeostasis is defined as the maintenance of a state of equilibrium within the body.

According to Guyton Medical physiology, homeostasis is the maintenance of static, or constant, condition in the internal environment. Essentially all the organs and tissues of the body perform functions that help to maintain these constant conditions.

FAMOUS FIRSTS IN HOMEOSTASIS

The renowned physiologists and scientific theologians who discussed homeostasis are:

■ Claude Bernard   (1859)

■ Water, B. Canon   (1932)

    Physiologist of Harward University

■ Ala Hazrat Imam Ahmad Raza Khan Bareilvi (1856-1921) Asian Muslim scientific theologian of the 20th century.

The research study tells us that in 1859, Claude Bernard (physiologist) recognized that internal bodily processes are maintained in a state of equilibrium.

It was not until 1932, however, that water B. Cannon, a prominent physiologist of Harward University realized that the concept of equilibrium was a fundamental principle of homeostasis. He introduced the concept of homeostasis, in his book "The wisdom of the body" Norton 1932. His main concern was with the bodily process themselves but he was aware that homeostasis is also related to behaviours.

The most eminent theologian, the world has ever known, Ala Hazrat Imam Ahmad Raza Khan Bareilvi (1856-1921) discussed the concept of balance system of internal bodily processes (especially gastro intestinal system-homeostasis in his book, "Maqam-i-ul-Hadid 1886.

According to the concept of homeostasis, the body functions as a system that constantly works to keep its vital functions in a state of balance. Furthermore, all of these processes must be co-ordinated with one another to produce a state of balance between input and output.

For example, maintenance of a particular range of temperature, fluid content, blood sugar level, acid base level and so on. This maintenance of an overall physiological balance is homeostasis. That is the need for food and fluid, the need to breath, the need to eliminate wastes, the need to rest, the need for many substances circulating in the blood etc are all parts of homeostasis system.

Regarding homeostasis and co-ordinated control system, it can be explained that lungs provide oxygen to the extracellular fluid to replenish continually the oxygen that is being used by the cells, the kidneys maintain constant ion concentrations, and the gastro intestinal system provides nutrients as discussed by Imam Ahmad Raza in 1886 in his book Maqam-i-ul-Hadid.

Regarding homeostatic mechanism, different functional systems of the body are briefly discussed.

THE EXTRACELLULAR FLUID TRANSPORT SYSTEM - THE CIRCULATORY SYSTEM

It has been observed that extracellular fluid is transported through all parts of the body in two different stages. The first stage entails movement of blood around and around the circulatory system and the second, movement of fluid between the blood capillaries and the cells. All the blood in the circulation traverses the entire circuit of the circulation with a time period of an average of once each minute at rest while as many as six times each minute when a person becomes extremely active.

As blood circulates through the capillaries, continual exchange of extra cellular fluid takes place between the plasma portion of the blood and the interstitial fluid by diffusion that fills the space between the cells, the inter- cellular space. This process of diffusion is caused by kinetic motion of the molecules in both the plasma and the interstitial fluid. Thus, the extracellular fluid every where in the body, both that of the plasma and that in the interstitial spaces, is continually being mixed, thereby maintaining almost complete homogeneity.

ORIGIN OF NUTRIENTS IN THE EXTRA CELLULAR FLUID

a) RESPIRATORY SYSTEM

It has been observed that each time the blood passes through the body, it also flows through the lungs. The blood picks up oxygen in the alveoli needed by the cells. It has been observed that the membrane between the alveoli and the lumen of the capillaries is only 0.4 – 2.0 micrometer in thickness, and oxygen diffuses through this membrane one into the blood exactly in the same manner that water (H_2O) and ions diffuse through the tissue capillaries.

b) <u>THE GASTROINTESTINAL TRACT</u>

It has been observed that a large portion of the blood pumped by the heart passes also through the walls of the gastro intestinal organs. Here different dissolved nutrients, including carbohydrates, fatty acids, amino acids, and others are absorbed into the extra cellular fluid.

C) <u>THE LIVER AND OTHER ORGANS THAT PERFORM PRIMARILY METABOLIC FUNCTIONS</u>

The biological research study tells us that not all substances absorbed from the GITcan be used in their absorbed form by the cell. The liver changes the chemical compositions of the substances to more usable forms, and other tissues of the body-the fat cells, the gastrointestinal mucosa, the kidneys, and the endocrine glands - help to modify the absorbed substances or store them until they are needed at a later time.

REMOVAL OF METABOLIC END PRODUCTS

<u>Removal of CO_2 by the lungs:</u> It has been observed that carbon dioxide (CO_2) is the most abundant of all the end products of metabolism. As we know that blood picks up oxygen in the lungs, at the same time, carbon dioxide (CO_2) is released from the blood into alveoli. In this way by the respiratory movement of air into and out of the alveoli, CO_2 is carried out to the atmosphere.

THE KIDNEYS

It has been observed that different end products of cellular metabolism and excess of ions and water accumulated in the extracellular fluid are removed from the plasma as the blood passes through the kidneys. By the process of filtration by the kidneys, needed substances like glucose, amino acids, appropriate amounts of water and ions are reabsorbed into the blood while metabolic end product, ------ is excreted out into the urine.

REGULATION OF BODY FUNCTION

Regarding homeostasis, body functions are regulated by two systems:

■ The nervous system of regulation.

■ The hormonal system of regulation.

THE NERVOUS SYSTEM OF REGULATION

The nervous system is composed of 3 major parts.

■ The sensory portion

- Central nervous system or integrative portion)

- The motor portion

Sensory receptors detect the state of body or the state of surroundings with the help of:

- Touch receptor (skin)

- Visual receptor (eyes)

- Hearing receptors (ears)

Central nervous system is composed of the

- Brain and

- Spinal cord

The brain can store information, generate thoughts, create ambition, and determine reactions. Appropriate signals are then transmitted through the motor portion of the nervous system to carry out the person's desires.

A large segment of the nervous system is known as autonomic nervous system. It operates at a subconscious level and controls many functions of the internal organs, including the action of the heart, the movements of the gastrointestinal tract, and the secretion by different glands.

THE HORMONAL SYSTEM OF REGULATION

Hormones are the chemical substances secreted by the eight major endocrine glands in the human body. Hormones are transported in the extracellular fluid to all parts of the body to help in the regulation of cellular function. For instance, thyroid hormone increases the rates of most chemical reactions in all cells.

Insulin controls glucose metabolism. Adreno cortical hormones control ion and protein metabolism. Para thyroid hormone controls bone metabolism. Thus, the hormones are a system of regulation that complements the nervous system. Regarding homeostasis, this discussion shows that the nervous system regulates mainly muscular and secretory activities of the body while the hormonal system regulates mainly the metabolic functions.

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RESEARCH OF IMAM AHMAD RAZA
ON LEPROSY

Leprosy is an ancient disease of man involving skin and peripheral nerves. Leprosy is a chronic, granulomatous disease, caused by mycobacterium Leprae.

There was a time when leprosy was considered to be a divine curse and sufferers were hated because of communicable disease. With the result they died without receiving any treatment.

This article, "Leprosy is non-communicable disease" Islamic research by Ala Hazrat Imam Ahmad Raza Bareilvi (1856-1921) in his book, Al-Haquel Mujtala-Fe-Hukmel Mubtala 1905, has opened up new avenues to success. Because the more the modern science is going to unfold the realities of the universe, the more the Islamic truths become evident.

FAMOUS FIRSTS IN RESEARCH OF LEPROSY

- Daniel and Boeck   (1847-1873)
- Prof. Henrick Armauer   (1873-1960)
- Shepard   (1960)
- Imam Ahmad Raza   (1856-1921)

Modern research now claims that leprosy is no more communicable which favours the Islamic research offered by Imam Ahmad Raza in 1905. So Imam Ahmad Raza surpassed the Muslim world and his Islamic as well as scientific contributions will be remembered with pride.

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IMAM AHMAD RAZA & MEDICAL EMBRYOLOGY

Embryology is a branch of Medical science which deals with the fertilized cell (zygote) uptil full development (intra uterine development - 9 months).

FAMOUS FIRSTS IN EMBRYOLOGY

- Leonardo da vinci   (1452-1519)
- William Harvey   (1578-1657)
- Girolamo Fabricius   (1537-1619)
- Anton Von Leeuwenhoek   (1676)
- Caspar Friedrich Wolff   (1759)
- Heinrich Christian Pander   (1817)
- Karl Ernst Von Baer   (1827)
- Wilhelm His   (1831-1904)
- Franklin P.Mall   (1862-1917)
- Wilhelm Roux   (1850-1924)
- Louise Brown   (1978)
- Ala Hazrat Imam Ahmad Raza   (1856-1921)

Amongst them, Imam Ahmad Raza is the first Muslim scientific theologian who has explained medical embryology in his books.

As Samsam-Ala-Mushkkik-Fe-Ayah-Uloom-il-Arham 1896.

✳ Maqam-e-ul-Hadid Ala Khadil Mamtaqil Jadid 1886, covering the topics of

- Transport, fertilization and implantation of developing ovum at the uterus.
- Cleavage-cellular division.
- Manifestation of providence during pregnancy and nursing.
- Early intrauterine nutrition of the embryo, function of placenta.
- Intrauterine development of human body, its various stages and organ formations like,
- Skeletal system
- Muscular system
- Integumentary system (skin system)
- Vascular system
- Fetal development within 3 veils of darkness, (abdominal wall, uterine wall, amniochoronic sac).
- Fetal development within 3 layers.

■ Formulation of ultra sound machine, on the basis of reflection & refraction of light – piezoelectric phenomenon.

In short, the above mentioned discussion shows that Ala Hazrat Imam Ahmad Raza Bareilvi (1856-1921) is the only Muslim creative theologian of the 20th century who has distinctive command regarding various scientific subjects, so he surpassed his contemporaries and his scientific as well Islamic contributions will be remembered with pride.

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EARTH THEORY

Physics is the most fundamental science, concerned with the basic principles of the Universe. It is one of the foundations on which the other physical sciences like Astronomy, Chemistry and Geology (earth science) are based.

Regarding Physics, Mechanics is of vital importance from all disciplines. It is highly successful in describing the motion of material bodies, such as Planets, Rockets and baseballs.

FAMOUS FIRSTS IN EARTH THEORY

Regarding earth theory, the famous firsts are:

1. Nicolas Copernicus　　(1473-1542)

　　　　　　　　　Poland

2. Galileo Galilee　　　(1564-1642)

　　　　　　　Italian Physicist & Astronomer

3. Johannes Kepler　　(1571-1630)

　　　　　　　German Astronomer

4. Isaac Newton　　　(1642-1727)

　　　　　　English Physicist & Mathematician

5. Albert Einstein　　　(1879-1955)

　　　　　　German Physicist

6. Alahazrat Imam Ahmad Raza Khan Bareilvi

　　　　　　(1856-1921)

　　　　　　Muslim Scientific theologian

Asian Physicist, Astronomer, Mathematician, Philosopher, Psychologist, Elegant Jurist of the Muslim World, a poet and renowned Scholar of the Islamic Sciences.

Galileo formulated the laws that govern the motion of objects in free fall. He also investigated the motion of an object on an inclined Plane and established the concept of relative motion.

According to Isaac Newton, the gravitation is the intrinsic property of matter that every particle of matter attracts every other particle with a force that is directly proportional to the product of their masses and is inversely proportional to the square of the distance between them.

According to Einstein theory, space time is curved especially locally near massive bodies. This theory doesn't tell us about the force of gravity acting on the bodies, instead we say that bodies and light rays move along geodesics (equivalent to straight

lines in plane geometry) in curved space time. Thus a body at rest or moving slowly near the great mass would follow a geodesic toward that body rather force of gravity.

According to Imam Ahmad Raza, the Islamic theory (based on Quran and Hadith) explains that earth is static. In favour of his theory, Imam Ahmad Raza has written several treatises like:

- *Nuzool-i-Ayat-i-Furqan Besukoon-i-Zameen-o-Aasman 1919.*
- *Mueen-i-Mubin Bahar Daur Shamas-o-Sukoon-i-Zameen 1919*
  (Eng.trans: A fair guide on the revolving sun and the static earth.)
- *Fauz-i-Mubin Dar Radd-i-Harkat-i-Zameen 1919.*
  (Eng: Trans: A fair success refuting motion of earth).

In his first treatise, Imam Ahmad Raza has discussed earth theory in the light of Quran and Hadith that earth and sky are static by coding several verses from the Holy Quran.

In his second treatise, Imam Ahmad Raza has elaborated that sun is in motion while earth is static based on astronomical observations and calculations. Most probably, Dr. Abdul Qadeer Khan, the renowned Physicist and Atomic Scientist of the Muslim World has appreciated the arguments of Imam Ahmad Raza regarding motion of sun.(ref: Mujalla Imam Ahmad Raza 1998)

In his treatise "*Fauz-i-Mubin* " Imam Ahmad Raza has not only proved that earth is static with 105 argumentations in the light of Modern Physics, but also criticized the ideas of the renowned scientists like, Copernicus, Galileo, Kepler, Newton and Albert Einstein. In his book "*Fauz-i-Mubin* " Imam Ahmad Raza has discussed various scientific spheres of knowledge including Physics, Chemistry, Geology, Astronomy and Astrology, Mathematics, Logarithm, covering the topics of Planetary motion in the Orbits and the Physical mechanics like attractive and repulsive forces, Centripetal force, Centrifugal force, friction coefficient, projectile motion, relative velocity, circular speed, buoyant force, density & pressure, structure of earth, theory of tides and distance from the sun, along with dozens of geometric diagram representations with algebric, logarithmic and mathematical calculations.

CONCLUSION:

According to Modern Physics, the rest and motion are not absolute but are relative. Also, the rest and motion depend on the observer and its frame of reference. As we are on the earth, so

earth is static with respect to us which favours the argumentations of static theory of Imam Ahmad Raza.

It is interesting to note that Imam Ahmad Raza is the first Muslim scientific theologian of the 20th century who made rich creative scientific contributions regarding Modern physics like static theory of earth.

In the end, I would like to suggest that to make the new generation conversant with the scientific work of Imam Ahmad Raza, it is necessary that various Seminars/Symposiums should be arranged at national/international level where significant research scholars may vehemently discuss the informative scientific work of Imam Ahmad Raza that can bring about a guideline in the scientific era.

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THE END