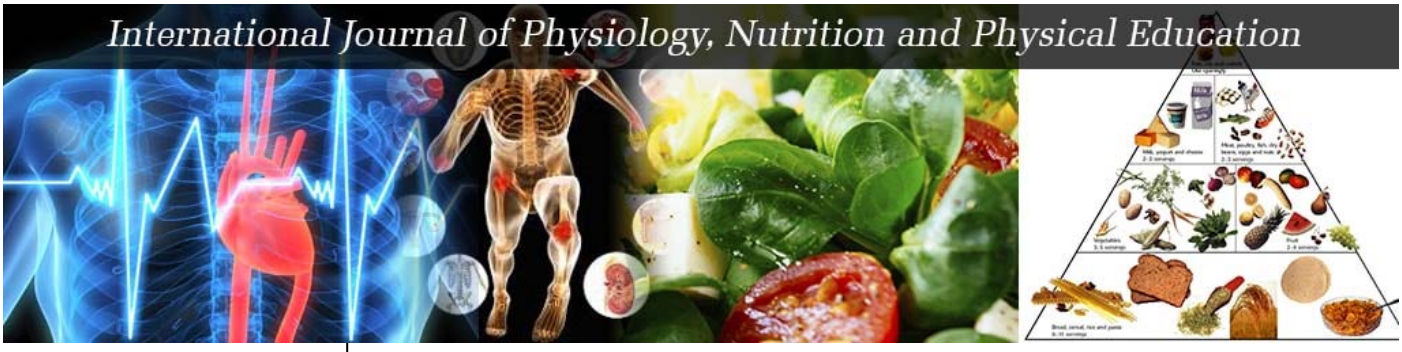

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Dr. Huma Noor
Lecturer, Sanskriti Unani Medical College & Hospital, Sanskriti University, Mathura, Uttar Pradesh, India

Dr. Mohd. Anus Ansari
Research Scholar, Department of Kulliyat, Ajmal Khan Tibbia College, Faculty of Unani Medicine, Aligarh Muslim University, Uttar Pradesh, India

Correspondence
Dr. Huma Noor
Lecturer, Sanskriti Unani Medical College & Hospital, Sanskriti University, Mathura, Uttar Pradesh, India

A logical overview of *Quwā Mudrika* and *Afa'l Mudrika* receptive faculties

Dr. Huma Noor and Dr. Mohd. Anus Ansari

Abstract
Background: With the evolution of man, medical science also has been reached up to nano-technology from macroscopic and observational illustration. Tibb has complete knowledge and sense of human body based on fact full theories. In present era science means evidence based study which must justify how and why about the things. The interpretation of the things must be done in the light of ancient and modern science, to conclude and understand the logics and philosophies with respect to current aspect. Ancient philosophies may be right in all aspects at that time or it could be partially wrong or misunderstood due to lack of resources. With the advancement of the technologies new information are being added to the basic Unani principles.
Purpose: The aim of this paper is to analyze the *Quwā Mudrika* (Faculty of Perception) in the light of ancient and modern science to make a track that would give the right direction to understand the Unani Tibb. This paper is a step to take Greece literature up to date with the help of modern knowledge without changing or discarding the definitions and terms of Unani system of medicine. *Umūr Ṭabī'iyya* deals with the each and every aspect of human body that are anatomy, physiology, biochemistry and biophysics. In this paper *Quwā Mudrika* is being illustrated with respect to its anatomy, and physiology in brief.
Conclusion: The chapters of *Umūr Ṭabī'iyya* must be look like this approach and to the learners of Unani system of medicine; it should be presented as *Quwā Mudrika* has been presented in this manuscript.

Keywords: *Quwā Mudrika, receptive faculty, Afa'l Mudrika, unani*

Introduction
According to *Majoosi*, *Quwā Nafsāniyya* is that faculty which perform *Ḥiss* (sensation), *Idrāk* (cognition), and *Tehreek* (movement) in the body [1]. Organs pertaining to these faculties are called the psychial or mental organs i.e. brain, spinal cord and nerves. Brain is considered to be the supreme member of this group i.e. seat of *Quwā Nafsāniyya* (*Buqrat*). The human brain is the body's control centre that receives and sends signals to other organs through the nervous system and hormones. It is responsible for thoughts, feelings, memory storage and general perception of the world. According to *Ali Abbas Majoosi* and *Abu Sahl Masihi,* this faculty is composed of three sub faculties*: Quwā Mudrika* (Perceptive faculties), *Quwā Muḥarrika* (Motor faculties), and *Quwat-e-Mudabbira* (Faculty of planning and mind or intellectual faculties) [1]. While *Ibne Sina* assumes that it is of two types' one is *Quwā Mudrika* and other is *Quwā Muḥarrika* [2]. The whole but concise illustration will be done in this paper, and this *Unani* classical literature of *Quwā Mudrika* will be analysed with the advanced knowledge of the topic.

A logical approach to describe *Quwā Mudrika* and Its Functions: According to *Ibne Sina*, *Quwā Mudrika* is of two types, the *Quwā Mudrika Zahira* (External Senses) and *Quwā Mudrika Baṭina* (Internal Senses). Each of this type is subdivided into five types. The five types of *Mudrika Zahira* are concerned with five senses [2]. Aristotle classified five traditional human senses as follow sense of touch (*Quwwat Lāmisa*/Tactile Sensation), sense of tatse (*Quwwat Dhā'iqa*), sense of smell (*Quwwat Shāmma*/Olfaction), sense of sight (*Quwwat Bāṣira*/Vision**)**, & sense of hearing (*Quwwat Sāmi'a*/Audition). These five senses had been described by every Unani scholar in description of *Quwā Mudrika Zahira* [1-4].

It consists of sensory neurons, sensory receptors cell, neural pathway, and parts of the brain involved in sensory perception. Senses are transducers from the physical world to the area of the mind where we interpret the information of the world around us [5, 6].

Organs of Perception & their Centres: *Quwwat Bāṣira*/Vision: The organ of perception is eye. The real centre is *Ḥassas akhir* (*Ibne Haitham*) i.e. occipital lobe specially the calcarine sulcus that is also recognized as visual cortex or Brodmann area number 17. Here, visual impulses are received and the form of the object is perceived (visual sensory area). Nerve supply for this area is optic nerve i.e. second cranial nerve [7, 8].

***Quwwat Sāmi'a*/Audition:** The organ of perception is ear. The centre for *Ḥiss-e-Sama'at* is temporal lobe (forebrain-cerebrum). In Area 41, (heschl's gyrus) and adjoining part of superior temporal gyrus (Area 22) the pitch, loudness and quality of the sound are perceived. The nerve supply of this area is 8th cranial nerve i.e. vestibulo-cochlear nerve [7, 8].

***Quwwat Shāmma*/Olfaction:** The organ of perception is nose. The centre for *Ḥiss-e-Sham* is situated in the uncus and hippocampal gyrus in temporal lobe. Nerve supply of this area is 1st cranial nerve i.e., olfactory nerve [7, 8].

***Quwwat Dhā'iqa*/Taste:** The organ of perception is tongue. Centre for *Ḥiss-e-ẓoaq* is situated in the inferior part of the post central gyrus. Nerve supply of this area is 7th and 9th cranial nerves [7, 8].

***Quwwat Lāmisa*/Tactile Sensation:** The organ of perception is skin. Centre for *Ḥiss-e-Lams* is situated in somesthetic area in parietal lobe i.e., post central gyrus of the fore brain.

The cranial nerves provide motor and sensory innervations mainly to the structures within the head and neck. The sensory innervations include both general sensation such as temperature and touch, and special innervations such as taste, vision, smell, balance and hearing. Without the information we receive through our five senses we could not function as the beings we are.

According to *Majoosi* the nervous faculty is of two types that causes sensation and movement. These are present in all living beings while the cognitive faculty is present in human beings only. He says; the residing place for these cognitive faculties is the brain. Types of these faculties are three; first is *quwwat-e-mutakhayyalah* that brings out takhayyul (imagination), second is *quwwat-e-mufakkirah* that causes *fikr-e-mantiqi* (logical thinking) and the third is *quwwat-e-mutazakkirah* that producing *zikr* (recall) means remembering things. Among these fikr is like a pillar for *takhayyul* and *zikr*. For these faculties there is a specific center in brain [1].

According to the ancient Greece scholars the center for *takhayyul* is the *muqaddam batan* (anterior chamber) of the brain, the center of *fikr* is the *ausat batan* (middle chamber) of the brain and the center of *zikr* is *mu'akkhar batan* (posterior chamber) of brain. The word *batan* means hollow space or ventricle so in place of *muqaddam batan*, *ausat batan* and *mu'akkhar batan* one should use the word *muqaddam dimag*, *ausat dimag* and *mu'akkhar dimag* [2, 9, 10].

***Quwā Mudrika Baṭina* (Intellectual Faculty of the Brain): *Quwā Mudrika*:** This faculty receives all kinds of sensory stimuli from different sensory receptors and send them to the brain in their respective internal centres. The five types of interior faculties are *Ḥiss Mushtarak* (Composite Sense), *Quwwat-i-Khayāl* (Faculty of Awareness), *Quwwat Wāhimah* (Faculty of Apprehension), *Quwwat Mutaṣarrifa* (Faculty of Modification), and *Quwwat Ḥafiẓa* (Faculty of Memory) [2, 5, 6, 9, 10].

Functions of *Quwā Mudrika Baṭina*: Processing, splitting and integration of sensory information with respect to their form and meaning are the main function of this power. It also compares new information with the old information preserved in the memory loci. Perception of the forms of the things, storage and memorisation of the forms and meaning of the things is also one of important task of this power. *Thoughts* **(**the product of mental activity, an idea or opinion produced by thinking or occurring suddenly in the mind, and the awareness of itself can be defined as consciousness), *memory* (capability of recalling a thought at least once and usually again and again), *learning* (capability of *Quwat-e-Nafsaniyah* to store memories) and *consciousness* are all the functions of intellectual faculty of the brain [5, 6].

How Intellectual Faculty Works: Firstly this faculty focuses its attention on specific type of information. Secondly the different qualities of each set of information signals are split away from the central signal and are transmitted to multiple areas of the brain. Thirdly, the mental faculty compares new information with old information in its memory loci. Lastly the mental faculty determines the pattern of stimulation. Different centres of the brain react to specific qualities of information: Reticular formation and certain regions of the thalamus and hypothalamus to the pain, regions of the mesencephalon and hypothalamus to the effective nature of sensation like pleasant or unpleasant and somatic cortex to the localisation of the sensation [6].

***Ḥiss Mushtarak/Bintasiya* (*Composite sense/Common Sense*):** Power of perception which receives all sensations, composes them into percepts and enables proper sensory appreciations. The writer of *Firdaus al-Hikmat* i.e. *Rabban Tabri* also named this power as *Bintasiya* [11]. It collectively perceives particular forms which have been perceived by the five external perceptive faculties with their respective external sense organs.

According to Unani scholars the centre for this faculty is anterior brain which holds true as the angular gyrus is the area situated in forebrain (region of the brain in the parietal lobe), links information from primary and unimodal sensory areas. It is responsible for the assembly of auditory, visual, and somatosensory information. Another area is a tiny pea-sized area on the brain stem called the superior colliculus which combines sound and vision for the purpose of object localization [7, 8]. *Quwwat-i-Khayāl* (Faculty of Awareness) is the treasure house of *Ḥiss Mushtarak*.

Tools of Perception: There are some receptors by which all types of senses reach to the *Ḥiss Mushtarak*. The initialization of sensation is the response of a specific receptor to a physical stimulus. Receptors which react to the stimulus and initiate the process of sensation are characterized in four distinct categories: *chemoreceptor, photoreceptors, mechanoreceptors, thermo receptors*. All receptors receive distinct physical stimuli and transduce the signal into an electrical action potential. This action potential then travels along afferent neurons to specific brain regions where it is

processed and interpreted. It always requires perception (*Idrāk*) from two or more senses to conclude the result. Gnostic area of cerebrum (areas 5, 7, 39, 40) helps to integrate all incoming senses pattern, so that a common thought can be formed (correlated) using all arriving sensory information. Damage to the angular gyrus manifests as Gerstmann syndrome. Its damage may impair one or more of the functions like dysgraphia/agraphia (deficiency in the ability to write), dyscalculia/acalculia (difficulty in learning or comprehending mathematics), finger agnosia (inability to distinguish the fingers on the hand), and left-right disorientation occurs [7, 8].

Quwwat Khayāl **(Faculty of Awareness):** One of the intellectual faculties which preserve the knowledge perceived by *Ḥiss Mushtarak.* It is that sense with which new sensory experiences of same or similar types can be compared. It preserves the forms of things perceived by *Ḥiss Mushtarak*. It preserves the percept of the composite sense conjoined and holds them after the sense impressions have subsided. According to *Unani* philosophers the faculty of memory is of two folds i.e. one is meant for the storage of forms of the things which are known as *Khayāl* and the other one is for the storage of meaning of the things which is known as *Hafizah*. *So it is the power of memory which preserves the forms of the things perceived by Ḥiss Mushtarak.* The seat of this faculty is posterior part of the forebrain. According to *Unani* scholars the centre for this faculty is also the anterior part of brain. This is the treasure house of *Ḥiss Mushtarak* [2, 5].

The analytical overview of this faculty is as follows; first, look at the role of the amygdala in memory formation. The amygdala is almond shaped groups of nuclei located deep and medially within the temporal lobe of the brain where it causes a bulge called the uncus. It performs a primary role in the processing of memory, decision making, and emotional reactions. The medial nucleus is involved in the sense of smell. The lateral amygdala receives input from the sensory systems. It is also involved in the modulation of memory consolidation. The hippocampus is also involved in memory, specifically normal recognition memory as well as spatial memory. The hippocampus is a major component of the brain as the portion of the cerebral hemisphere in basal medial part of the temporal lobe. There are two hippocampuses, one in each side of the brain. It contains two main interlocking parts: the hippocampus proper and the dentate gyrus. This part of the brain is important for learning and memory, for converting short term memory to long term memory. Lesions of hippocampus do not affect old, established memories. These lesions affect new declarative learning [7, 8].

Quwwat Wāhimah **(Faculty of Apprehension):** It decodes the meaning of those particular forms perceived by *Ḥiss Mushtarak.* It decides what is in favour of the individual and what is against. This is also performed by the process of analysis and integration and is sub served in the association areas of the brain. Whole brain is the place for this *Quwā* (Power), but the mid brain is the main seat of it. Due to loss of this faculty one can read the printed words but unable to recognise the meanings, and the thought that is conveyed i.e., receptive aphasia (Wernicke's aphasia; Wernick's area in the brain (Brodmann area 22) in the posterior part of the superior temporal gyrus of the dominant hemisphere) is a disorder of this faculty in which an individual is unable to understand language in its written or spoken form [7, 8].

Similarly one can hear perfectly well and can even recognize different words but still he/she is unable to arrange these words into coherent thought. In area 18 the meaning of visual image is interpreted and integrated such as meaning of written language. In area 22, 21 and 20 complete associative meaning of a sound is recognized. Area number 5, 7 are the association areas for perceiving the meaning. One of the jobs of the hippocampus is to project information to cortical regions that give memories meaning and connect them with other connected memories. It also plays a part in memory consolidation: the process of transferring new learning into long-term memory. Injury to this area leaves us unable to process new declarative memories, unable to form new semantic knowledge, loss of the ability to form new memories, yet he could still remember information and events that had occurred prior to the surgery [7, 8].

Quwwat Mutaṣarrifa **(Faculty of Modification):** It is that faculty which modifies various sensory information in many ways i.e. by processing, splitting, integrating, matching etc. It processes sensory information in such a way that appropriate motor response may occur. This faculty also called as *Quwat Mufakkira* (Power of Justification) because it produces modification in *Fikr* (thought). Seat of this *Quwā* is whole brain. It is also called *Quwā Mutkhayalah* faculty of imagination. As it produces abstract thoughts, ideas and imaginations and produces modifications in their forms and meanings by the process of splitting and integration [5, 6]. More than 99% of all sensory information is continually discarded by this faculty as unimportant. And the important sensory information is selected and channeled into proper motor regions of the brain to cause the desired response by motor faculty. There processing is conducted by synapses which performs selective action. After processing different types of information, this power focuses on specific type of information before sending to proper motor area. Now the splitting in the different qualities of each set of information takes place and are transmitted to other areas. This faculty compares new information with old information in its memory loci. And at last the pattern of stimulation and function is determined. This process of analysis, splitting and integration serves the *Ḥiss Mushtarak* and *Quwat Wahimah* in the performance of their functions.

According to Unani physicians the seat of this faculty is entire brain because it takes forms and meanings of things from different part of brain for processing, splitting, integration, matching etc. but its centre is *ausat dimagh* (mid brain) because the midbrain acts as a bridge to transmit signals from hindbrain and forebrain. These signals mostly come from the senses of touch and hearing, collected by the specialized organs, i.e. skin and ears, respectively. The upper part of the midbrain is called optic tectum that serves to integrate visionary and auditory data [1-3].

Quwwat Ḥafiẓa/Zakira/Mutazakkira/Mustarji'a **(Faculty of Memory):** The power of memory is a treasury or repository for those supra sensuous ideas discovered by the apprehensive faculty, just as the imagination as the treasury repository for the sense impression of forms and sensible imaging. It is the faculty of memory which preserves the meanings of things i.e. thought in the memory loci for minutes, weeks or years and then can help the bodily reactions at some future dates. Memory can also be divided into three types as: *Instantaneous* memory, *Fixed* memory (under this short term and recent memory comes) and *long* term memory. Human memory has some types according to the duration and nature

of memory that are as follow: *sensory* memory, *short term* memory and *long term* memory. *Sensory* memory is responsible for the memorising of the things that has the time duration of some seconds, while pertain the things for minutes comes under the *short term* memory (*working* memory). *Long term* memory stands for to pertain the things for the years or life time. *Long term* memory is of two types expect and *implicit* memory (memory of unconsciousness). *Explicit* memory (memory of consciousness) consists of *declarative* memory (memory of facts and events) that further has two types one is *episodic* memory (memory of events and experiences) and other is *semantic* memory (memory of facts and concepts). *Implicit* memory is responsible for *procedural* memory that is for tasks and skills of a person [7, 8].

According to Unani scholars the centre for this faculty is in the posterior region of the brain i.e. hind brain [3]. Three brain areas do play significant roles in the processing and storage of different types of memories: cerebellum, hippocampus, and amygdala. The cerebellum's job is to process procedural memories. The hippocampus is where new memories are encoded. The hippocampus plays important roles in the consolidation of information from *short term* memory to *long term* memory. Lesions of hippocampus do not affect old, established memories. These lesions affect new declarative learning. The amygdala helps to determine what memories to store. The cerebral cortex plays a key role in memory, attention, perceptual awareness, thought, language and consciousness. Amygdala lesion interferes with memory processes for emotional events. Amygdala damage can result in abberant social behaviour. Hippocampal damage can result in anterograde amnesia: loss of ability to form new memories, although older memories may be safe [7, 8].

Limbic system: It is a set of brain structures located on both sides of the thalamus, immediately beneath the cerebrum. Limbic means border and it names structures forming a border between hypothalamus and cerebral cortex. It is the area of intimate processing between the hypothalamus and cortical information processing. This system supports a variety of functions including: emotion, behaviour, motivation and formation of long-term memory and olfaction. Emotional life is largely housed in the limbic system, and it has a great deal to do with the formation of memories. This system often referred to as the emotional brain. This system contains the thalamus, hypothalamus, amygdala, and hippocampus [7, 8].

Thalamus: It is a large mass of gray matter deeply situated in the forebrain at the topmost portion of the diencephalon. It functions as relaying of sensory and motor signals to the cerebral cortex, and the regulation of consciousness, sleep, and alertness. It is located in the forebrain between the cerebral cortex and the midbrain, with nerve fibers projecting out to the cerebral cortex in all directions. The medial surface of the thalamus constitutes the upper part of the lateral wall of the third ventricle, and is connected to the corresponding surface of the opposite thalamus by a flattened gray band, the interthalamic adhesion. Almost all sensory information enters into this structure where neurons send that information to the overlying cortex. Axons from every sensory system (except olfaction) synapse here as the last relay site before the information reaches the cerebral cortex. For example, inputs from the retina are sent to the lateral geniculate nucleus of the thalamus, which in turn projects to the visual cortex in the occipital lobe. The thalamus is believed to both process sensory information as well as relay it each of the primary sensory relay areas receives strong feedback connections from the cerebral cortex. The thalamus also plays an important role in regulating states of sleep and wakefulness. Thalamic nuclei have strong reciprocal connections with the cerebral cortex, forming thalao-cortico-thalamic circuits that are believed to be involved with consciousness. The thalamus plays a major role in regulating arousal, the level of awareness, and activity [7, 8].

Midbrain: Mesencephalon is the rostral part of the brain stem, which includes the tectum, tegmentum, cerebral aqueduct, and cerebral peduncles, as well as several nuclei and fasciculi. Caudally the midbrain adjoins the metencephalon (pons and cerebrum); while rostrally it adjoins the diencephalon (thalamus, hypothalamus, etc). The midbrain acts as a bridge to transmit signals from hindbrain and forebrain. These signals mostly come from the senses of touch and hearing, collected by the specialized organs, i.e. skin and ears, respectively. The upper part of the midbrain is called optic tectum, which serves to integrate visionary and auditory data [7, 8].

Pons: The pons can be broadly divided into two parts; the basilar part, located ventrally, and the pontine tegmentum, located dorsally. A number of cranial nerve nuclei are present in the pons; pontine nucleus and motor nucleus of the trigeminal nerve (V), abducens nucleus (VI), facial nerve nucleus (VII), and vestibule-cochlear nuclei (VIII). The functions of these four cranial nerves (V-VIII) include sensory roles in equilibrium, hearing, taste, and in facial sensations such as touch and pain, as well as motor roles in eye movement, facial expressions, chewing, swallowing, and the secretion of saliva and tears [7, 8].

After analyzing these powers and their respective centres in the brain it should be kept in mind that the areas and the parts that are not discussed here are also help to perform all these functions like hypothalamus, midbrain, and medulla. Each and every part of brain is responsible for doing all the functions performed by brain. In this paper required knowledge with respect to *Quwā Mudrika* has been discussed to analyze this power.

Fact that differentiates human from animals: *Quwwat-e-Insaniya Natiqa also known as Aqal/ Tameez* (Sense) is found only in human being, animals do not have this power. This power is responsible for perception of the Kulliyat. That is why human being can perceive both Kulliyat as well as juziyat aspect of the things. While animals only can perceive the juziyat of the things. It means that quwaate wahima is found in both human and animals but quwwate aqila/natiqa is only found in human beings [2, 3].

Conclusion

It is *Quwat-e-Mudrika* (*Zahira and Baṭina*) which is responsible for the perception of different things, movements, thought, process, emotions, and memory. Functions of intellectual faculty are performed with the interrelationship and collective functioning of all the branches of *Quwat-e-Nafsaniya*. The most important characteristic which differentiates human beings from other animals is extraction of Kulli ma'ni along with Juzai ma'ni.

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