RUSSELL. The new realism of Moore and Russell views human ideas, both of common sense and of the sciences, as logical or linguistic constructions of sense data. In the early stages of LOGICAL POSITIVISM it was assumed that the data of the senses were the only possible objects of direct observation; a proposition must either be given a meaning in terms of sense data or be discarded as meaningless. From a Cartesian starting point, Moore found himself in the dilemma of attempting to resolve how a self aware only of sense data could transcend these data. By holding that the objects of self are simply the specific sense qualities, Moore denied himself the material to work out a conclusive theory of perception. His appeal to sense phenomena inevitably led him back to the position of Hume.

Critique. The limitation of experience to singular sense experiences, however, results in the inability to provide an adequate foundation for universal ideas or for scientific knowledge. Mere phenomenal similarity or the imaginative association of ideas is not adequate to uphold necessity or universality. On the other hand, to limit human experience to sensibly verifiable phenomena is to fail to be sufficiently empirical, for a thoroughgoing empiricism demands that all factors of human experience be acknowledged and explained.

Although there is intimate involvement between intellectual acts and sense representations, moderate or critical realists recognize a real distinction between sense images and intellectual concepts. The latter represent natures or essences of things abstracted from sensible qualities, e.g., ''life,'' ''truth,'' ''humanity,'' and ''existence.'' Even the concepts of sensible qualities are abstract and universal, e.g., ''color'' and ''redness.'' This abstract and universal character of concepts is never experienced in any sensation or image, for these always represent existing and concrete phenomena.

See Also: CERTITUDE; EPISTEMOLOGY; KNOWLEDGE, PROCESS OF; KNOWLEDGE, THEORIES OF; PHENOMENALISM; SENSIBLES; SENSISM.

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Humorous illustration of ''The Five Senses.'' (©Historical Picture Archive/CORBIS)

SENSES

The senses are the immediate principles of sensation. They have an organic structure that is scientifically observable and are energized by an operative power or faculty of the soul, a fundamental source of vital energy. Organic structure and vital energy or power are intrinsically linked to make a unique reality, namely, sense.

The existence of the external senses is obvious; ordinary experience recognizes most of them, and scientific observation confirms and completes its findings. As will be seen, the existence and nature of the internal senses is problematic. The organic structure of the external senses must be sought in the peripheral and central nervous systems. Sensory receptors that are anatomically and functionally discernible and are specifically affected by different typical stimuli are generally distinguished. The peripheral organ's stimulation unleashes in the connector nerve fibers afferent influxes that rise to the brain along complex routes, intersected by synaptic relays. In the brain these influxes terminate in different zones. It is in these zones that attempts are made to pinpoint specific centers for each sensation. The internal senses, without peripheral organs, are all found in the brain or at its base.

External Senses

Five senses are traditionally noted: sight, hearing, smell, taste, and touch. Aristotle considered these sufficient for knowing all sensible qualities, although he recognized that touch is a complex sense (*Anim.* 424b 22–425a 13). St. THOMAS AQUINAS followed Aristotle's lead seeking to make the distinction of the senses more precise: he classified them according as (1) the modification needed for sensation is made (*a*) by direct contact with the sensible (touch and taste), or (*b*) through an intermediary, and then (i) with an alteration of the sensible (smell), or (ii) by local movement (hearing), or finally (2) without any modification either of the sensible or of the organ—sight—a position that is no longer tenable (*In 3 de anim.* 1.583).

Principle of Classification. Even if the experimental criteria of the ancients and the scholastics were scientifically imperfect, the functional principle they used to classify the senses was and is valid. Since the senses are passive powers, they are distinguished from each other in terms of the external SENSIBLES that are capable of affecting them. This principle is still applied in experimental psychology, but with greater precision owing to developments in physics, physiology, neurology, etc., all of which give better understanding of the stimulus-object and the receptor-subject.

A stimulus is defined as an energy pattern that arouses a sensory receptor. Sensory receptors, reacting to specifically distinct stimuli, constitute as many different senses. Beginning with this fundamental distinction made with respect to stimuli, a difference can be noted among receptors by considering the proper organs, the nerves linking these organs to the brain, and the zones of the brain where the nerves terminate. In this way sight and hearing are very clearly distinguished. Smell and taste are similarly dissociated, despite the close chemical interdependence between them. The criteria for distinction applied to touch can be physiological (e.g., epicritic and protopathic sensibility), functional (e.g., kinesthesis), qualitative (e.g., heat and cold), or perceptual (e.g., hunger and nausea). These criteria serve as cross-checks upon each other. For all practical purposes, distinctions can be made among (1) tactile or cutaneous sensitivity that selectively perceives pressure, pain, warmth, and cold; (2) deep organic sensitivity, namely, kinesthesis or proprioception for muscular sensation, and deep touch for the viscera and internal organs; and (3) vestibular function, localized in the semicircular canals, for the positioning and movement of the body in equilibrium, a function that works in harmony with kinesthesis and deep touch.

Seat of External Senses. Common experience has always recognized organs adapted to the various senses. It was also known that somewhere in the organism there must be a central reference point or some kind of principle for external sensation, but this was long unidentified. While attributing some role to the brain in sensation, Aristotle, followed almost unanimously by his commentators, made the heart the main organ or *sensorium* for all the external senses (*Somn. vig.* 454a 4–6; *Sensu* 439a 1). Advances in the biological and physiological sciences have shown the importance of the nervous system in their structure and functioning.

Problems concerning the seat of the external senses may refer to their peripheral organ, or to the ascending nerve fibers, or finally, to the brain. Although enough is known about the superior senses as regards the structure of the peripheral organ, many questions arise concerning touch. Histological and electro-physiological techniques are used in attempts to localize the sensitive points of the skin, to study the different subcutaneous nerve endings, and to determine their respective roles in the reception of tactile impressions, such as pain and temperature. The question of the transmission of sensation through nerve fibers has been dominated, for more than a century, by the theory of specificity of nervous energy of Johann Müller, elaborated to include in the same explanation often disconcerting phenomena (e.g., the production of different sensory impressions while the same stimulus, electricity for example, is applied to various receptors). According to Müller, specificity could reside in the nerve itself; its central portion would conduct this type of influx, thus transmitting this type of stimulus. It could also be localized in the region of the brain where the various sensory nerves terminate. The discovery of an almost constant identity of neural excitation in the various nerves at first led to the belief that it was at the level of the cerebral endings that specificity of sensations had to be sought. But if it has been possible to localize with sufficient precision the subcortical structures serving as relays to sensory impressions, as well as their cortical projections, it has also been recognized that the brain too exercises a universal influence. What counts is not so much the cortical centers as such, but rather their functional integration in a total pattern of reaction within the nervous system. There is reason to distinguish structurally between a peripheral organ and a central organ of the external sense, but functionally each must be considered as inseparably bound in the production of sensation.

Objects of the External Senses. Noting that the senses know only when they are moved by external things, Aristotle preceded his study of the objects of the various external senses by reflections of a general nature on the object of all senses considered together (*Anim.* 416b 33–418a 25). The external senses' object is called a sensible because it can modify the sense. It appears as

a complex ensemble that acts upon the senses in many ways. There are, first of all, qualities capable of specifically stimulating this or that sense, to which they belong as their own immediate sensibles (*sensibilia per se propria*). These qualities, however, exist as properties of quantified material realities; thus they are located in space and time, and are subject to movement. They therefore affect also the senses in a way that is related to these quantitative aspects. Because these can act simultaneously upon many senses and are common to all of them, they are designated as common sensibles (*sensibilia per se communia*). Finally, these quantitatively conditioned qualities manifest the natures of material realities, as well as their functional value for the knowing subject. Perception of these natures and of these values is made possible by the activity of the senses, but immediately surpasses simple sensation and requires other principles of knowing (e.g., the COGITATIVE POWER and the INTELLECT), whose proper operation it constitutes. Considered from this angle, such realities can be seen as mediate proper sensibles (*sensibilia per accidens*).

Internal Senses

Apart from the external senses, whose knowing activity does not explain all the riches of sensible experience, the existence of other principles of knowledge must also be recognized. These are the internal senses, so called because they contact external reality only through the intermediary of the external senses.

Principle of Classification. To identify these principles of knowledge, whose nature and distinction are not revealed with the same evidence as is available for the external senses, one must investigate functions of sense knowledge that are irreducible to the external senses. These functions must be grouped around specific objects; whatever functions cannot be referred to the same object must then require distinct principles of operation. Such is the methodological principle given by St. Thomas, who thus arrives at the following four internal senses (*Summa theologiae* 1a, 78.4).

Central Sense. The CENTRAL SENSE (*sensus communis*) is necessary for consciousness of sensation, which is impossible for the external senses because their organic structure prohibits reflection on themselves. It is also needed to explain comparisons between sensations of the various senses, comparisons that no sense can make since it does not know the objects of the other senses.

Imagination. The IMAGINATION registers the impressions unified by the central sense to reproduce these subsequently, sometimes with fanciful elaborations. According to St. Thomas, the organic structure of the central sense does not permit it to retain its own impressions. Moreover, functioning in synergy with the external senses, the central sense knows reality only when this actually affects the senses, whereas the imagination brings back the image of these realities known in their absence.

Cogitative Power. Through data arriving from the external senses, the central sense, and the imagination, the cogitative power (*vis cogitativa*) detects values whose perception escapes these inferior powers (*intentiones insensatae*). These include the functional meaning of reality for the subject and the existence of this reality as concrete, individual, and reducible to a general category (*individuum existens sub natura communi*).

Memory. The memory stores up these experiences and recalls them later, under the stimulus of analogous experiences, to situate them in a type of temporal continuity that is measured by the projection of perception toward the past. This assures the continuity of experiences lived by the subject and is indispensable for organizing his personality.

Seat of Internal Senses. Since the internal senses are organic cognitive powers, they occupy a definite, experimentally identifiable place in the nervous system. Faced with the complexity of the problems of cerebral localization, one must be indulgent here with the scholastics, whose imperfect knowledge of anatomy and physiology led them to very conjectural formulations. In modern times there is agreement in recognizing that complex psychic functions are isolated with difficulty and that their unfolding involves activities of the entire brain.

According to M. B. Arnold, the central sense must be sought in the sensory cortex needed for various sensations (visual, auditory, etc.) as well as in the connector areas and the associative fibers. The preservation of images probably takes place by the cortex's registering impressions that come from the various external senses. Contrary to what St. Thomas believed on this matter, Arnold wonders if it is not physiologically necessary to link the preservation of these images to the central sense and assign their reproduction specifically to the imagination. Be this as it may, the activity of the imagination seems to require the concurrence of the associative cortical areas as well as of numerous subcortical structures: hippocampus, amygdaloid nuclei, fornix, and sensory hypothalamic and thalamic nuclei. All these regions seem to be selectively reactivated according to demands for the simple recall of images or for the formation of fanciful images. The cogitative power would use certain nerve endings linked to the medial thalamus and to the limbic cortical areas, together with specific activation of the mammillary bodies and the hippocampus. Memory would set in motion the associative cortex, the limbic areas, the hippocampus, and the fornix up to the anterior

thalamic nuclei. W. Pensfield has shown how the ganglia at the base of the brain cooperate in registering lived experience.

Modern Problems. Are the internal senses distinct cognitive powers or simply various functions of one and the same knowing power? While Aristotle considered imagination and memory simply as activities of the central sense (*Anim.* 429a 1–2; *Memor.* 450a 11–12), his commentators came to attribute functions of superior sensible knowledge that were irreducible to one operative principle to as many distinct powers. The progress of the science of man, especially of experimental psychology and neurophysiology, should eventually produce an answer to this question. The matter of identifying the organ for these functions is of prime importance, although contemporary scholastic philosophers have shown little interest in the problem. Yet various investigations begun by Arnold and J. A. Gasson, W. W. Meissner, M. Ubeda Purkiss, and others promise fruitful results. In general they seem to confirm the intuitions of the scholastics who, centuries ago, laid a foundation for classifying the superior psychic functions of sensibility with their theory of the internal senses.

See Also: SENSATION; SENSE KNOWLEDGE

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[A. M. PERREAULT]

SENSIBLES

Those features or aspects of reality that can be perceived by the SENSES; in scholastic terminology, the proper objects of the various senses. Aristotle and the scholastics distinguish between the ''proper'' and the ''common'' sensibles, whereas most modern thinkers since the time of J. LOCKE regard the sensibles as ''primary'' and ''secondary'' qualities. Sense qualities that can be perceived by a single external sense, such as color, sound, taste, smell and tactile sensations, are the proper sensibles or secondary qualities, while qualities that are perceived by more than one sense, such as extended surface, shape, volume, number, rest and motion, are the common sensibles or primary qualities.

Perception. The common sensibles are not apprehended in the abstract by any joint action of the senses. The individual, concrete data from which the INTELLECT abstracts such thought objects as magnitude or three-dimensional extension are complex data gleaned from more than one external sense. These composite sense data do not contain any sense element beyond the proper sensibles contributed by the separate senses in cooperation. Thus the perception of a common sensible involves the conscious coordination of the proper objects of vision and of tactile, muscular and motor sensations. Yet common sensibles are real objects of sense awareness, *sensibilia per se,* unified by the integrating internal sense faculty known as the CENTRAL SENSE, the *sensus communis* of the Aristotelian-Thomistic tradition. Both the common and the proper sensibles, being direct data of sense perception, are percepts, not concepts. While the senses reveal the concrete complex of perceived qualities, the intellect apprehends the knowable object as a real substance having a specific nature or essence as determined by the perceived qualities.

The sensory and intellectual activities involved in perceptual and conceptual processes cannot be isolated as though sense perception in the human adult were prior to and independent of intellection in any simple and unqualified sense. The mind as a principle of intelligence possesses the tendency to form sensory data into some kind of perceptual whole or pattern, to render the extramental environment intelligible. The distinction between primary and secondary qualities should therefore not be pushed to excess, as though any sensible quality can be perceived independently of all relations to the senses. However, to attain a philosophical analysis of these relations, one must strive for some knowledge of the absolute terms that are related.

Objectivity. Thinkers in the Aristotelian-Thomistic tradition consider both primary and secondary qualities to have objective existence in extramental reality. GALILEO, Locke and many modern critical realists, on the other hand, hold that primary qualities have objective existence but that secondary qualities do not.

To the realist, the resistance one directly encounters from external objects is something proper to the objects themselves. Granted that vibrations of an atmospheric medium may be quite unlike the sensations of sight and hearing, it is nonetheless by the senses that the vibrations are discovered. The senses do not judge, they merely report the presence of certain sense impressions. Reason