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EVOLUTION OF THE DIGESTIVE SYSTEM?—I CAN'T SWALLOW THAT

Brad Harrub, Ph.D.

INTRODUCTION

Hydrochloric acid (HCL) is one of the most corrosive and toxic compounds known. Most students of general chemistry can recall extensive safety instructions on the proper use and storage of this hazardous substance. Chemistry labs are commonly equipped with eye stations and showers that will rapidly wash off any accidental spills to prevent extensive burning. The material safety data sheet (MSDS) indicates that hydrochloric acid is "toxic, corrosive, and dangerous for the environment." It goes on to warn that "ingestion may be fatal. Liquid can cause severe damage to skin and eyes" (see MSDS). Yet, this very substance is secreted on a daily basis into the human stomach!

Stomach acid poses a serious "chicken or egg" problem for evolutionists. The acids (as well as other enzymes produced by the pancreas and liver) are **required** to break down proteins and fats. Yet, the body must have some sort of protective barrier that provides protection against the corrosive action of the acid. The acid **must** be produced and stored in a protective container that prevents damage to the rest of the body. Why would the body "evolve" this container if the acid was not present? If the acid was present without a resistant lining, the stomach would digest itself. **Either** situation leaves evolutionists without a functioning digestive system. A gradual, step-by-step evolutionary process is insufficient to explain the existence of the digestive system. Rational evaluation of the digestive process indicates that this system was created fully functional.

While many individuals mentally simplify the process of digestion into merely a tube that ushers food in and waste out of the body, the organs that comprise this system perform several different functions: ingestion, mastication, deglutition, digestion, peristalsis, absorption, and defecation. A deficiency in any one of these functions can cause problems that are then propagated on down the digestive system. Long-term deficiencies in any of these areas can lead to sickness and even death if the problem is not corrected. Life demands energy (i.e., food) for survival and growth—yet the Darwinian theory proclaims this system evolved. How does a living creature maintain existence without a fully functioning means of converting food into energy? The demand for a well-performing digestive system involving so many complex functions argues strongly for a Master Architect. Consider the evidence for the design in the human digestive system.

INGESTION

Probably the least complex of all the processes involved in the digestive process is ingestion. During this step, food is introduced to the digestive system by the mouth. As Van de Graaff and Fox observed: "The functions of the mouth and associated structures are to **form a receptacle for food, to initiate digestion through mastication**, to swallow food, and to form words in speech" (1989, p. 851, emp. added). However, this opening that we commonly take for granted, does not come without a serious "expense." The mouth opens up the body to the environment—an environment filled with bacteria, fungi, dust, etc. It is estimated that more than 400 bacterial species reside in the oral cavity (Sugawara, et al., 2002, 8[6]:465), which can lead to inflammation and infection. For instance, immune compromised patients often struggle with infections of *Candida albicans* (yeast) that are contracted through the mouth.

The oral mucosa (or lining of the mouth), along with saliva, act as a primary defense

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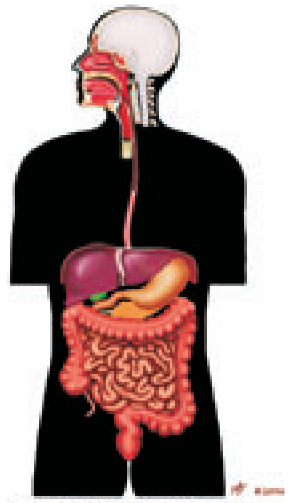


DIGESTIVE TRACT

mechanism against a variety of microbes. Sugawara and colleagues remarked: "Oral mucosal cells such as epithelial cells are thought to act as a physical barrier against the invasion of pathogenic organisms" (8[6]: 465). In a review on oral mucosal immunology, D.M. Walker noted: "The intact stratified squamous epithelium (mucosal cell layer—BH) supported by the lamina propria (layer of connective tissue underlying the epithelial layer—BH) **presents a mechanical barrier to oral microorganisms**. The continuous shedding by exfoliation of epithelial squames **limits microbial colonization** of the surface" (2004, 33:27S, emp. added). He went on to indicate that "[t]he flow of saliva has a mechanical effect, flushing microorganisms from mucosal and tooth surfaces. Saliva also contains important antimicrobial agents..." (33:27S).

Just what type of antimicrobial agents have scientists discovered in the mouth? Dale and Fredericks observed:

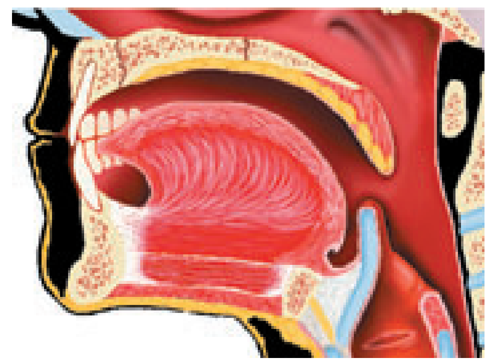
> The oral cavity is a unique environment in which antimicrobial peptides play a key role in maintaining health and may have future therapeutic applications. Present evidence suggests that alpha-defensins, beta-defensins, LL-37, histatin, and other antimicrobial peptides and proteins have distinct but overlapping roles in maintaining oral health and preventing bacterial, fungal, and viral adherence and infection (2005, 7[2]:119).

But this defense does not occur randomly. There must be a regulatory agent responsible for the production of such antimicrobials. As Sugawara, et al., concluded: "These results suggest that innate immune responses of oral epithelial cells to bacterial components are **regulated** in the inflammatory process" (2002, 8[6]:465, emp. added). The obvious questions are when and how did these oral antimicrobial agents originate, and where does the regulation take place? How long was the oral cavity in existence before these antimicrobials "evolved"? Regulation indicates that the brain (or some organ able to perform a feedback mechanism) is also required for this process—yet the brain requires energy that comes from the digestive system. The evolutionary theory cannot adequately explain any sequence of events that would place all of the required structures in place—simultaneously—that could provide sufficient defense for the oral cavity in order to make ingestion a safe, everyday activity. Ingestion, as simple as it may sound, required an Intelligent Designer.

MASTICATION

Food and the ability to metabolize food are essential for life. Thus, all living things must have the means to acquire and ingest food. The esophagus—the muscular tube connecting the mouth to the stomach—is flexible and able to move food to the stomach. But it does have limitations on its diameter and the portion size that is being swallowed. As such, food often must be pulverized before it is swallowed. This grinding and tearing of food is called mastication—a process that requires teeth.

Humans are diphyodont, meaning they normally have two sets of teeth which develop at different periods in a person's



lifetime. For instance, deciduous (or "baby") teeth normally begin to erupt at about six months of age (Van de Graaff and Fox, 1989, p. 853). Permanent teeth replace deciduous teeth in a predictable sequence—providing adults with thirty-two teeth. The thirty-two permanent teeth can be divided into incisors, canine, premolars, and molars (see Netter, 1994, p. 50). Was it by "trial-and-error" that humans evolved "baby teeth" that enable young children to eat until their mouths grow large enough to hold permanent teeth?

Because of their function, teeth must endure a great deal of "wear and tear" as the body prepares food to be swallowed. The constant friction and abrasion from mastication demands that the surface of teeth be extremely resilient. The primary component of teeth is dentin—a substance similar to bone but harder. As Moore indicated: "Most of the tooth is composed of dentin that is covered by enamel" (1992, p. 739). The enamel that covers teeth is formed as organized mineral in a specialized protein matrix. "Enamel has the highest concentration, for any structure in the body, of mineral at ~90%. **The proteins**

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in enamel are not found elsewhere and they are called enamelins and amelogenins" (See "Tooth Enamel," n.d., emp. added). If these proteins are the product of evolution, then how did cellular ribosomes know the correct sequence and folding structure for proteins that are not found anywhere else?

As food is chewed, the tongue is also employed in mastication. The placement and origin of the tongue also pose an interesting dilemma for evolutionists. Consider for a moment the size and placement of the tongue. If the tongue were too large then it would interfere with digestion and respiration. If it were not in the floor of the mouth it would constantly be in the way during mastication. R.L. Wysong questioned:

> How did humans develop the involuntary ability to chew food, avoiding the tongue? Can you imagine having to think your tongue into the correct places in your mouth to manipulate food and avoid biting it prior to this involuntary ability? Surely, if this ability was developed gradually, macerated tongues would have been a definite problem while the transitional stages were evolving between voluntary tongue manipulations and involuntary control (1976, p. 339).

Dr. Michael Shirley, a dentist who has been practicing family dentistry since 1989, commented: "The design pattern of teeth is too intricate a development process to have originated from a series of random selective events" (2006). He pointed out that the shape, contours, and angulation of teeth make it possible to grind and tear, whereas without proper angulation and contour, teeth would simply shred and poke holes. Shirley compared the ideal fit of upper and lower teeth with two cogs of a wheel coming together at precisely the right point. He went on to observe that he has identified several things in his practice that have never been reported in the hominid fossil record—for instance, a patient who possessed two full-functioning sets of wisdom teeth. Shirley pointed out that there have been occasions in the scientific literature where teeth were initially judged to be hundred's of thousands of years old, only later to be discovered to be only hundred's of years old. In evaluating the evidence that he has seen come through his office, he noted: "You don't want to just follow after intellectual scientists dogmatically, because after all, they may be giving you sporadic, partial, or incorrect information. The evidence truly points toward design" (2006).

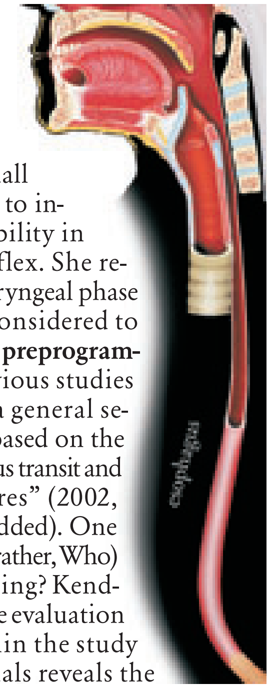
DEGLUTITION (SWALLOWING)

Once food has been thoroughly chewed, it is mixed with saliva and a bolus is formed. *Stedman's Medical Dictionary* defines bolus as: "a masticated morsel of food ready to be swallowed" (McDonough, 1994, p. 133). This process, known as deglutition (from the Latin *deglutire,* meaning to gulp), **combines both voluntary and involuntary muscles** of the head and neck. Because we swallow so often, this reflex is routinely taken for granted, but consider just how coordinated the muscles must be in order to prevent food from entering the trachea and lungs. The three steps of deglutition are as follows:

> The first stage is voluntary and follows mastication, if food is involved. During this stage, the mouth is closed and breathing is temporarily interrupted. A bolus is formed as the tongue is elevated against the palate through contraction of the mylohyoid and styloglossus muscles and the intrinsic muscles of the tongue. The second stage of deglutition is the passage of the bolus through the pharynx. The events of this stage are involuntary and are elicited by stimulation of sensory receptors located at the opening of the oral pharynx.... This stage is completed in one second or less. The third stage, the entry and passage of food through the esophagus, is also involuntary.... The entire time for deglutition varies, but it is slightly more than one second in the case of fluids and five to eight seconds with solid food material (Van de Graaff and Fox, p. 861).

In 1971, evolutionist William Beck released a book titled *Human Design,* in which he described the "highly specialized musculature" function of swallowing as being "quite complex" (p. 518). Complex indeed! In their textbook *First Principles of Gastroenterology,* Thomson and Shaffer observed:

> **The act of deglutition is a complex reflex activity.** The initial phase is under voluntary control. Food is chewed, mixed with saliva and formed into an appropriately sized bolus before being thrust to the posterior pharynx by the tongue. Once the bolus reaches the posterior pharynx, receptors are activated that initiate the involuntary phase of deglutition. This involves the **carefully sequenced** contraction of myriad head and neck muscles. The food bolus is rapidly engulfed and pushed toward the esophagus by the pharyngeal constrictor muscles. Simultaneously there is activation of muscles that lift the palate and close off and elevate the larynx in order to prevent misdirection of the bolus (1994, p. 90, emp. added).



Katherine Kendall conducted a study to investigate the variability in the swallowing reflex. She remarked: "The pharyngeal phase of deglutition is considered to occur in a reflexive, **preprogrammed** fashion. Previous studies have determined a general sequence of events based on the mean timing of bolus transit and swallowing gestures" (2002, 112[3]:547, emp. added). One should ask who (or rather, Who) did the programming? Kendall concluded: "The evaluation of variability within the study group of individuals reveals the **complexity of the swallowing mechanism** and underscores the importance of not relying on general guidelines in evaluating the coordination of swallowing gestures..." (112[3]:547, emp. added). Are we to conclude that this complex mechanism evolved by random processes over millions of years?

The story does not end there. Before the bolus of food can be swallowed it must be mixed with saliva, which initiates the breakdown of starches and helps carry the bolus down the esophagus. Van de Graaff and Fox observed: "Salivary glands are accessory digestive glands that produce a fluid secretion called saliva. Saliva functions as a solvent in cleansing the teeth and dissolving food chemicals so they can be tasted. Saliva also contains enzymes, which digest starch, and mucus, which lubricates the pharynx to facilitate swallowing" (1989, p. 856). In their well-known textbook on biochemistry, Donald and Judith Voet elaborate, noting: "Saliva contains α-amylase, which randomly hydrolyzes all the α(1 > 4) glucosidic bonds of starch except its outermost bonds and those next to branches. By the time thoroughly chewed food reaches the stomach, where the acidity inactivates α-amylase, the average chain length of starch has been reduced from several thousand to fewer than eight glucose units" (1995, p. 262). Does this complex degradation of starches via the saliva found in the mouth sound like a random accident?

Consider also that saliva glands are involuntary—that is, they secrete saliva as needed. How did this feedback loop come into existence? Saliva glands also require a blood vessel supply and nerve innervation. Once again, we should be reminded that difficulties with swallowing can result in malnutrition and even death. The Darwinian theory is not plausible in explaining the existence of this complex process as a sudden "finished product" that was intelligently designed.

DIGESTION

General biology textbooks present digestion as simply a tube that extends from the mouth to the anus, with absorption taking place somewhere in between. In their biology textbook, Raven and Johnson remarked: "The first great evolutionary change in digestion was the advent of a digestive cavity, which for the first time permitted animals to digest particles larger than a cell" (1989, p. 969). They then complete the evolutionary scenario:

> The first true extracellular digestion among animals occurred with the evolution of the roundworms, or nematodes (phylum *Nematoda*). The members of this group have a tubular gut composed of endoderm; the gut runs from their mouth to their anus. Food moves through it on a one-way journey, being digested and absorbed along the way. Although the details have been modified in many ways, **this same general strategy is employed by all of the more complex animal phyla** (p. 969, emp. added).

Is digestion simply a matter of absorption through the walls of a modified tube? Consider the observation of Wayne Jackson:

> The stomach is a truly remarkable structure. It is able to digest materials which are compositionally much tougher than it is. 'We would have to boil our food in strong acids at 212° Fahrenheit to do with cookery what the stomach and intestines do at the body's normal temperature of 98.6°'[Miller and Goode, 1960, p. 108]. Another incredible thing about the stomach is the fact that though it consists of flesh, it does not digest itself! (2000, p. 40).

Consider some of the differences found among digestive systems in the animal kingdom. Birds possess a crop and gizzard, which are located before the stomach and facilitate grinding up food before it reaches the stomach. This structure is not found in mammals. From whence did it evolve? Additionally, vertebrates do not produce cellulase, the enzyme required to breakdown cellulose. However, many creatures depend on cellulose for nutrition and have overcome this by utilizing bacteria that live within their digestive tracts to produce the necessary enzyme. For instance, cows possess a four-chambered stomach with a digestive pouch known as a rumen. Starr and Taggart noted:

> Ruminants swallow partially chewed plant material, which moves into two stomach-like chambers. Then they regurgitate the material, chew it more, and swallow it again. The double chewing time mechanically breaks apart the plant material, which contains tough cellulose fibers. Symbiotic bacteria present in the digestive tract produce enzymes that can digest cellulose (1978, p. 434).

Symbiosis is when two organisms live close together and mutually benefit from their association. **One wonders how a four chambered stomach and this symbiotic relationship between bacteria and ruminants "evolved" in enough time for the animals to be able to digest food.** Termites, cockroaches, and other insects utilize protozoans rather than bacteria in order to break down cellulose. Rabbits employ a completely different process. As Raven and Johnson observed:

> Rabbits have evolved a bizarre but effective way to digest cellulose, a way that achieves a degree of efficiency similar to that of ruminate digestion, despite the fact that a rabbit's cecum is positioned behind the stomach, which precludes regurgitation and redigestion in it. Rabbits do this by eating feces, thus passing their food through the digestive tract for a second time. This second passage provides the rabbit with many of the important products of bacterial metabolism; rabbits cannot remain healthy if they are prevented from eating their feces and thus gaining the opportunity of digesting more of the cellulose in them (1989, pp. 981-982).

All of these processes make the animals dependent on bacteria (or protozoans) in order to break down food properly for digestion. This means these creatures are subject to, or influenced by, an outside source. This dependency argues strongly against the evolutionary theory which is dependent on natural selection and mutations to explain the existence of things today.

The beginning of digestion in humans occurs when a bolus of food leaves the mouth and is passed down the esophagus. Peristaltic action (discussed below) carries the bolus into the stomach where the mechanical and chemical breakdown of food is accomplished. In his textbook on clinical anatomy, Keith Moore noted: "The stomach acts as a food blender and reservoir where gastric juices digest the food. It is a very distensible organ" (1992, p. 161). This distension property is vitally important, as a rigid walled stomach would be unable to accommodate large meals and would cause serious digestive problems. Van de Graaff and Fox remarked: "The mucosa is shaped into numerous longitudinal folds called gastric rugae, which permit stomach distension" (p. 863). They went on to comment: "The functions of the stomach are to store food as it is mechanically churned with gastric secretions; to initiate the digestion of proteins; to carry on limited absorption; and to move food into the small intestine as a pasty material called chyme" [from the Latin *chymus* meaning juice—BH] (1989, p. 861). The *Oxford Companion to the Human Body* states that

> [t]he stomach expands to receive a meal, holds it for up to four hours depending on the amount of food, churning it to a pulp and initiating digestion, then passes it on by degrees into the duodenum. These functions **depend** on its muscular wall and the acid- and enzyme-secreting glands in its lining, all of which are under control of the autonomic nerves (Blakemore & Jennett, 2001, pp. 655-656, emp. added).

These descriptions do not sound like a simple tube that has undergone slight "modifications." Consider for a moment that parietal cells in the stomach release approximately two liters of hydrochloric acid and other gastric secretions per day. If the stomach did not possess a protective mucosal cell layer, the digestive action of the acid would begin to break down the stomach itself (e.g., peptic ulcers). The body's resistance to this acidic environment appears to be due to three interrelated mechanisms:

1. The stomach lining is covered with a thin layer of alkaline mucous;
2. The epithelial cells of the mucosa are joined together by tight junctions preventing the acid from leaking into the submucosa;
3. The epithelial cells that are damaged are exfoliated (shed) and replaced by new cells. This latter process results in the loss of about one-half million cells a minute, so that the entire epithelial lining is replaced every three days (Van de Graaff and Fox, p. 864).

Textbooks are silent as to how this special resistance arose. According to Raven and Johnson, this acid solution is actually about "150 millimolar HCl, and thus **3 million times more acidic than the blood**" (1989, p. 975, emp. added). The acid is essential in breaking food into molecular fragments that can then be passed on to the small intestine for absorption. The acid breaks the peptide bonds of proteins present in the bolus of food by pepsin under acidic conditions. **However, the production of the acid is finely-tuned—too much acid would make it impossible for the body to neutralize the acid as chyme was passed into the small intestine, whereas too little acid would not sufficiently break down the food into molecular particles.** Raven and Johnson observed: "One of the principal digestive hormones, called gastrin, regulates the synthesis of hydrochloric acid by the parietal cells of the gastric pits, permitting such synthesis to occur only when the pH of the stomach content is higher than about 1.5" (p. 975). Do these authors (or any textbook authors) give suggestions as to how this impressive involuntary feedback loop for acid production occurred? Absolutely not. But that is not the end of the story.

The human stomach also contains vast amounts of bacteria. Sheryl Ubelacker remarked: "Ask anybody for a quick definition of the stomach and they might say 'a place for food' or 'acid-filled organ of the digestive system.' But what few people know is that the human stomach is home to a vast ecosystem of microbial life that appears to have adapted to one of the harshest biological environments imaginable" (2006). Elisabeth Bik and her colleagues identified the bacterial diversity that resides in the human stomach. They observed: "A diverse community of 128 phylotypes was identified, featuring diversity at this site greater than previously described.... This gastric bacterial rDNA data set was significantly different from sequence collections of the human mouth and esophagus described in other studies, indicating that the human stomach may be home to a distinct microbial ecosystem. **The gastric microbiota may play important, as-yet-undiscovered roles in human health** and disease" (Bik, et al., 2006, 103[3]:732, emp. added). They continued: "These findings are somewhat surprising and suggest the presence of distinct bacterial communities that have adapted to multiple specific environmental habitats in the stomach" (103[3]:736). David Relman, senior investigator of the study, remarked: "The vast majority of the bacterial world is relatively harmless to us. They don't typically cause disease and more so, **they may be very important to, may be an essential partner with us, in the maintenance of our own health**" (quoted in Ubelacker, 2006, emp. added).

In addition, the stomach possesses gastric enzymes such as pepsin, which are utilized in the digestion of proteins. Enzymes within the stomach must be able to act as biological catalysts even in very low pH environments. Moreover, the production of these special enzymes must be well maintained in order for proper chemical digestion to occur in the stomach. In his famous work, *Darwin's Black Box*, Michael Behe documented:

> The body commonly stores enzymes in an inactive form for later use. The inactive forms are called proenzymes. When a signal is received that a certain enzyme is needed, the corresponding proenzyme is activated to give the mature enzyme. As with the conversion of fibrinogen to fibrin, proenzymes are often activated by cutting off a piece of the proenzyme that is blocking a critical area. The strategy is commonly used with digestive enzymes. Large quantities can be stored as inactive proenzymes, then quickly activated when the next good meal comes along (1996, p. 81).

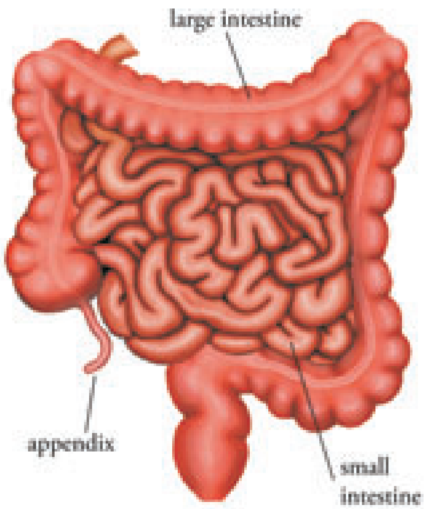
Are we to believe this multifaceted production and storage procedure of gastric enzymes arrived by chance?

PERISTALSIS

Most individuals are acutely aware of the low-carb craze that swept the nation recently. The premise was that by limiting carbohydrates and increasing proteins, individuals would lose weight. The rationale is that proteins are broken down in the stomach. Carbohydrates, on the other hand, are not digested in the stomach, but rather they are passed on to the small intestine, where they are converted to glucose and, if unneeded, stored as fat. In order to get the carbohydrates into the small intestine, the body is dependent on peristalsis—rhythmic, wavelike contractions that propel food through the digestive tract. Peristalsis was first described by Bayliss and Starling (1899) as a type of motility in which muscles surrounding the intestine alternate between contracted and relaxed states.

Consider the dilemma of an animal that has "evolved" the proper organs for digestion but is unable to move the food through the gut at a beneficial rate. Lest someone suggest that mere gravity is all that is needed to get food through this "modified tube," peristalsis is dependent on smooth muscles that line the digestive tract. Claude Villee and his colleagues noted: "Gravity is not necessary to pull food through the esophagus. Astronauts at zero gravity are able to swallow and even if you are standing on your head, food will reach the stomach!" (Villee, et al., 1985, p. 697). Bear in mind that these are **individual cells** that comprise the muscles that are acting in a coordinated fashion.

In describing the physiology of peristalsis, a Colorado State University Web site reports:



> Peristalsis is a manifestation of two major reflexes within the enteric nervous system that are stimulated by a bolus of foodstuff in the lumen. Mechanical distension and perhaps mucosal irritation stimulate afferent enteric neurons. These sensory neurons synapse with two sets of cholinergic interneurons, which lead to two distinct effects: One group of interneurons activates excitatory motor neurons above the bolus—these neurons, which contain acetylcholine and substance P, stimulate contraction of smooth muscle above the bolus. Another group of interneurons activates inhibitory motor neurons that stimulate relaxation of smooth muscle below the bolus. These inhibitor neurons appear to use nitric oxide, vasoactive intestinal peptide and ATP as neurotransmitters (see "Physiology of Peristalsis," 1995).

From a purely anatomical perspective, the nervous system, muscular system, arterial system, and a muscosal lining are all **required** in order for peristalsis to occur. Yet, all living creatures obtain metabolic energy for growth and activity through food. That means food is needed in order to develop and maintain a nervous system, muscular system, arterial system, and a mucosal lining. This places evolutionists in a significant quandary. Obviously it would be impossible for all of these systems to evolve by means of natural selection and mutations **simultaneously** at a rate that would allow all the systems to develop. So which systems evolved first? Growth and development are **dependent** on digestion; yet, digestion is dependent on peristalsis which, itself, is dependent on the other systems!

ABSORPTION

All of the processes described thus far would be utterly useless if the body was not able to absorb the food molecules as they passed through the intestines. Upon leaving the stomach, peristaltic action moves chyme through the pyloric sphincter into the small intestine. Raven and Johnson pointed out: "The small intestine is the true digestive vat of the vertebrate body. Within it, carbohydrates, proteins, and fats are broken down into sugars, amino acids, and fatty acids. Once these small molecules have been produced, they all pass across the epithelial wall of the small intestine into the bloodstream" (p. 976). The small intestine can be divided into three regions: the duodenum, the jejunum, and the ileum (Netter, 1994, pp. 262-263).

The duodenum is the hub of activity for digestion because not only does it receive chyme from the stomach, but it also receives bile from the liver and enzymes from the pancreas. As Starr and Taggart noted:

> Ducts leading from the pancreas and liver join to form a common duct that empties into the duodenum. Exocrine cells in the pancreas secrete enzymes into this duct in response to hormonal and neural signals. The enzymes digest carbohydrates, fats, proteins, and nucleic acids. For example, like pepsin in the stomach, the pancreatic enzymes trypsin and chymotrypsin digest proteins into peptide fragments. The fragments are then degraded to free amino acids by carboxypeptidase (from the pancreas) and by aminopeptidase (present on the surface of intestinal mucosa) [1978, p. 440].

Both the pancreas and liver are vitally important in maintaining a healthy digestive system—but the question remains: what evolutionary sequence can explain how the duodenum, pancreas, and liver all came into existence to function together to aid in absorption? In short, this complex system of ducts could not have evolved.

The Pancreas's Role in Digestion

The pancreas secretes enzymes into the digestive system and bloodstream. The primary role of these digestive enzymes is to breakdown the chyme into amino acids that can then be absorbed through the wall of the intestine. As Dr. David A. Demick noted:

> This is a formidable chemical job, for the food we eat is a very complex mixture of organic molecules. By way of comparison, just imagine for a moment putting into a car's gas tank all the different things that are used by the human body for fuel! The car's engine would be utterly unable to process them, as it can only use a few simple hydrocarbons. Yet, the body is able to process thousands of different kinds of carbohydrates, proteins, and fats. How is it able to do this? (Demick, 2003).

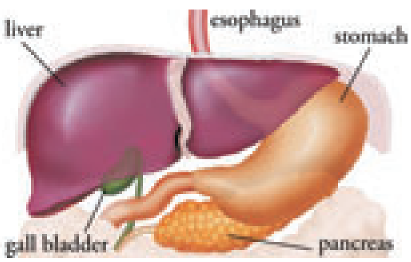
The production and storage of enzymes is no small task. Bear in mind that pancreatic enzymes are produced in cells—**however, cells are composed of proteins and fats, the exact molecules that these enzymes normally break down!** For instance, the pancreatic juice secreted in the duodenum contains: (1) amylase, which digests starch; (2) trypsin, which digests proteins; and (3) lipase, which digests triglycerides (Van de Graaf and Fox, p. 883). Under normal conditions these enzymes would break down the very cells that create them. The pancreas solves this problem by creating inhibitors that prevent the enzymes from working until they are needed in the small intestine. However, this is not the only hurdle evolutionists must cross. Consider also the diversity of this organ within the animal kingdom. Demick remarked:

> Another way the pancreas defies evolution is through its comparative anatomy. The pancreas in chordates occurs in two main forms, compact (one main organ) and diffuse (multiple small organs). Evolutionary theory would lead us to expect a steady progression of anatomic structure through fish, amphibians, reptiles, and mammals. This is not what anatomists have found. Instead, compact and diffuse forms occur in apparently random fashion in fishes and mammals, while reptiles and amphibians have a compact form. This creates an evolutionary conundrum. Why would a rodent pancreas look more like a fish pancreas than a human pancreas? This is another deep puzzle for evolutionists, but no problem at all for creationists (2003).

Thus, evolutionists must explain how the enzymes arose in the first place, how the pancreas was able to prevent itself from being digested, and why there is not a standard progression in the animal kingdom of pancreas anatomy. As Dr. Demick observed: "Considering that not even one functional enzyme has ever been produced by chance, it strains evolutionary faith to the utmost to believe that a whole host of finely counterbalanced functional proteins making up an integrated system could just happen by luck" (2003). An honest observer would recognize that this chemical engineering feat is the product of intelligent design.

The Liver's Role in Digestion

The liver holds the distinguished honor of being the largest glandular organ in the human body. In addition to performing as a filter for the circulatory system, it also secretes bile into the digestive system. *Stedman's Medical Dictionary* defines bile as "a yellowish brown or green fluid secreted by the liver and discharged into the duodenum where it aids in the emulsification of fats, increases peristalsis, and retards putrefaction" (McDonough, p. 122). Bile is stored and concentrated in the gallbladder, a small sac located posterior to the liver itself. One crucial role that bile plays in digestion is enhancing the breakdown and absorption of fats. One textbook noted: "Through the emulsifying effects of bile salts, pancreatic lipase has access to more triglycerides—hence fat



digestion is enhanced" (Starr and Taggert, p. 440). Additionally, the liver helps to regulate the concentration of blood glucose that is circulating in the bloodstream.

As the chyme is propelled through the small intestine, brush border enzymes attached to the cell membrane of microvilli further break down food into simple sugars that can be passed on to the bloodstream. Once the chyme leaves the small intestine, it enters the large intestine (so named because of its diameter) where very little digestive action occurs. The large intestine primarily absorbs water and electrolytes from the remaining chyme and aids in the preparation, storage, and expulsion of feces from the body. Understanding that mutations do not provide new raw material (i.e., the tissue needed to compose the liver, pancreas, or large intestine), **it should be obvious that the only acceptable scientific explanation for the well-designed digestive system is an Intelligent Designer.**

DEFECATION

Human digestion is reliant upon the body's ability to remove waste. For instance, humans who experience a blocked colon often require surgery, and the second leading killer of dogs is a condition known as gastric dilation-volvulus—bloat. Bloat occurs when the stomach twists and the contents are trapped in place as gas continues to build up. This life-threatening condition can kill a dog in a matter of hours. Consider the fate of the first creature that unsuccessfully tried to "evolve" a method to remove waste.

Often the ability to excrete bodily waste is taken for granted—until conditions such as diarrhea or constipation are present. Additionally, this final step in digestion brings the process back under voluntary control as the external anal sphincter is innervated by voluntary nerves. Consider for a moment how different this process would be if defecation relied solely upon gravity. The human body has been designed so that pelvic muscles can be employed in order to aid in removing waste from the body. Van de Graaff and Fox noted:

> During the act of defecation the longitudinal rectal muscles contract to increase rectal pressure, and the internal and external anal sphincter muscles relax. Excretion is aided by contractions of abdominal and pelvic skeletal muscles, which raise the intra-abdominal pressure and help push the feces from the rectum through the anal canal and out the anus (1989, p. 874).

Even the removal of bodily waste demonstrates purpose and design.

CONCLUSION

Each and everyday we introduce food and liquids into our bodies for energy. Even while we are carrying out our normal day-to-day activities, our bodies are busy behind the scene, converting food into energy for all of the cells that compose the human body. If the human digestive system were compared to a building, where energy is needed to provide heat and light, and plumbing is needed to provide water and to dispose of waste, it would require experienced engineers, master electricians, skilled carpenters, and well-trained plumbers—all working from the same set of blueprints—to construct a functional building. The human digestive system is infinitely more complex, and yet we are to believe it is simply the product of evolution? The only logical conclusion is that a Master Designer laid out the blueprints and then constructed the human digestive system the way we find it today. This intricate system is yet one more proof of God's handiwork.

REFERENCES

Bayliss, W.M. and E.H. Starling (1899), "The Movements and Innervation of the Small Intestine," *Journal of Physiology*, 24:99-143.

Beck, William (1971), *Human Design* (New York, NY: Harcourt, Brace, & Jovanovich).

Behe, Michael (1996), *Darwin's Black Box* (New York, NY: Free Press).

Bik, Elisabeth M., Paul B. Eckburg, et al. (2006), "Molecular Analysis of the Bacterial Microbiota in the Human Stomach," *Proceedings of the National Academy of Science*, 103[3]:732-737, January 17.

Blakemore, Colin and Shelia Jennett, eds. (2001), *Oxford Companion to the Body* (Oxford, UK: Oxford University Press).

Dale, B.A. and L.P. Fredericks (2005), "Antimicrobial Peptides in the Oral Environment: Expression and Function in Health and Disease," *Current Issues in Molecular Biology*, 7[2]: 119-133, July.

Demick, David A. (2003), "The Pancreas: An Important Organ that Defies Evolution," *Think & Believe*, 20[2], [On-line], URL: http://www.discovercreation.org/newlet/spring03.htm.

Jackson, Wayne (2000), *The Human Body: Accident or Design?* (Stockton, CA: Courier Publications).

Kendall, Katherine A. (2002), "Oropharyngeal Swallowing Variability," *Laryngoscope*, 112[3]: 547-551.

McDonough, James T. Jr., ed. (1994), *Stedman's Concise Medical Dictionary* (Philadelphia, PA: Williams & Wilkins), second edition.

Miller, Benjamin and Ruth Goode (1960), *Man and His Body* (New York, NY: Simon & Schuster).

Moore, Keith L. (1992), *Clinically Oriented Anatomy* (Baltimore, MD: Williams and Wilkins).

MSDS (2004), "Safety (MSDS) Data for Hydrochloric Acid (concentrated)," [On-line], URL: http://physchem.ox.ac.uk/MSDS/HY/hydrochloric_acid.html.

Netter, Frank H. (1994), *Atlas of Human Anatomy* (Summit, NJ: Ciba-Geigy).

"Physiology of Peristalsis" (1995), Colorado State University, [On-line], URL: http://www.vivo.colostate.edu/hbooks/pathphys/digestion/basics/peristalsis.html.

Raven, Peter H., and George B. Johnson (1989), *Biology* (St. Louis, MO: Times Mirror/Mosby College Publishing), second edition.

Shirley, Michael (2006), Personal Interview, March 1.

Starr, Cecie and Ralph Taggart (1978), *Biology: The Unity and Diversity of Life* (Belmont, CA: Wadsworth Publishing), fourth edition.

Sugawara, S.A. Uehara, R. Tamai, and H. Takada (2002), "Innate Immune Responses in Oral Mucosa," *Journal of Endotoxin Research*, 8[6]: 465-468.

Thomson, A.B.R. and E.A. Shaffer (1994), *First Principles of Gastroenterology: The Basis of Disease and an Approach to Management* (Mississauga, Ontario: Astra Pharmaceuticals), third edition.

"Tooth Enamel" (no date), Dental Find, [On-line], URL: http://www.dentalfind.com/glossary/tooth_enamel.html.

Ubelacker, Sheryl (2006), "Human Stomach Home to Vast Array of Bacteria, Some Surprising: Study," *The Canadian Press*, [On-line], URL: http://www.canada.com/ottawacitizen/story.html?id=dd87505c-c154-408d-a8cd-73ee7d339a6b&k=85003.

Van de Graaff, Kent M. and Stuart Ira Fox (1989), *Concepts of Human Anatomy and Physiology* (Dubuque, IA: Wm. C. Brown).

Villee, Claude A., Eldra Pearl Solomon, and P. William Davis (1985), *Biology* (New York, NY: Saunders College Publishing).

Voet, Donald, and Judith Voet (1995), *Biochemistry* (New York, NY: John Wiley & Sons), second edition.

Walker, D.M. (2004), "Oral Mucosal Immunology: An Overview," *ANNALS Academy of Medicine Singapore*, 33(Supplement):27S-30S.

Wysong, R.L. (1976), *The Creation-Evolution Controversy* (Midland, MI: Inquiry Press).

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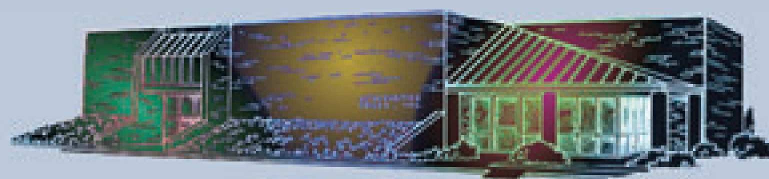

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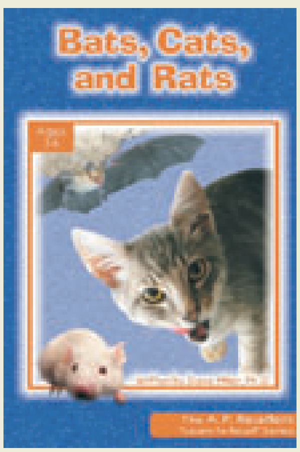

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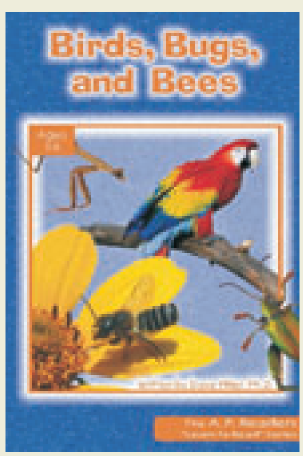

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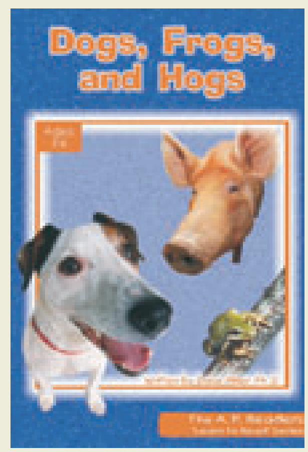

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