RUNGE (E.C.)

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Human Rumination Regarded in the Light of Atavic Tendency.—Report of a New Case with Results of an Investigation of Its Digestive Chemism.

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Before entering upon the discussion of the possible or probable causal factors leading to the establishment of the habit of rumination in man, I prefer, as a matter of convenience, to present first the case that has come under my observation, and all that pertains to it.

Mr. D——, a gentleman of Scotch-English parentage, aged thirty-seven, high grade teacher, married but without issue, came to me on December 18, 1893, seeking relief from an attack of indigestion. The train of symptoms complained of, was the usual: mental unrest and languor, headache, quite severe vomiting of a "bilious" nature, eructations of odorless gas, a sensation of fullness after eating, loss of appetite, but no pain. The

patient stated that he had been subject to similar attacks for many years; they even compelled him to interrupt his collegiate course for one year. The attacks had usually yielded readily to dietetic measures, and some anti-fermentative medication. Four years ago, the diagnosis of gastrectasis was made. I found that this conclusion had been reached by the general appearance of the case, and not by a thorough physical examination. In the course of my inquiry, the patient mentioned quite incidentally that he had been regurgitating his food after nearly every meal for many years. Upon pressing the subject, which the patient seemed to resent as irrelevant to the main issue in question, *i. e.*, his present complaint, I learned that the so-called regurgitation served the specific purpose of remastication. This fact convinced me that I was face to face with a genuine case of merycism; on repeated cross questioning, I ascertained that it had never before been placed on record.

The family history fails to record the existence of another merycole, or of any pronounced neuropathic tendency, but a weak stomach appears to have been a family heritage, for both parents, one aunt and a brother had been or are possessors of such a stomach. The patient is a man of that wiry type, the delicacy of appearance of which, is belied by a remarkable amount of physical endurance and nerve power. His height is 5′ 5″; his weight is with slight temporary variations about 120 pounds, pointing to a constant state of nutrition. He never used tobacco in any form, and does not

indulge in alcoholic beverages, except in an occasional glass of watered white wine. He cannot remember of having ever passed through any sickness of a serious nature, and at present does not reveal symptoms of any disorder of the nervous system, except an atony or muscular insufficiency of his stomach, and particularly that of its cardiac sphincter, a condition usually classified with the disturbances of function or neuroses.

The patient's recollections of the dawn of his ruminating life carries him back to the fields and woods of his native Scotland, where he, a lad of twelve, ate unmeasured quantities of bramble berries. To this indulgence, he ascribes the establishment of the ruminating habit, acknowledging at the same time, to have been always a fast eater, which by inference fastens upon him the vice of insufficient mastication. During twenty-five years, his food had come up to a greater or less extent after every meal, to be subjected to further mastication, and then to be swallowed again. This procedure is often repeatedly gone through with from a few to about one hundred minutes after the meal. The grosser portions of the food are selected with remarkable precision: meat and seed-fruits seem to be particularly apt to be returned, vegetables and bread less often, crackers when ingested in pieces of considerable size; the casein of the milk is regurgitated in lumps whenever milk is swallowed in large draughts. Peptonized milk, beef-peptones and fluids of any kind are never regurgitated. The taste of the regurgitated food assumes but rarely a disagreeable character; it is quite unaltered when re-

gurgitation occurs soon after the meal, and becomes of an acid nature of varying intensity, whenever the process takes place some time after, the patient not being able to define the exact time. On March 21, he visited me at 3:30 P.M., after having dined at 2:20 P.M. The fish eaten at the latter was regurgicated and remasticated during our conversation. Upon questioning I found that it had not lost any of its original flavor. The act of rumination occurs nearly always without the patient's consciousness being aroused to a sense of an effort. Nausea never precedes it. I had occasion to take note of the ease with which the patient is able to relieve his stomach of its contents. The effort of effecting this, never assumes the vehemence of a vomiting act. Whenever the patient goes to sleep after having eaten a heavy meal, he usually awakens with a sensation of great discomfort, and the regurgitations, on these occasions, are apt to be of a very distasteful nature. For this reason he avoids sleep on a full stomach. Past experience has taught him that he is at his best when he spends about three-quarters of an hour after eating in restful conversation, during which time the rumination is at its height; after that, a long walk seems to add greatly to the feeling of general well-being.

As a peculiar feature I may mention the following observation made by the patient on repeated occasions: whenever the ruminating act failed him, for some occult cause, he invariably suffered with regurgitation of bile into the stomach. I had an opportunity of verifying his observation, on, at least, one occasion. At our first

meeting, he stated that the regurgitation had been deficient for some days. I expressed the stomach, using a soft rubber tube, and found the expressa intermixed with bile, the presence of which was clearly demonstrated by Gmelin's test for bile pigments.

The physical examination made with reference to the condition, complained of at the time of the patient's first visit, was not expected to throw much light on the normal behavior of the stomach. I concluded to abide my time, and to relieve, if possible, the temporary disturbance. A course of morning auto-lavage was instituted, a procedure of no difficulty as the tube had to overcome but a slight pharyngeal reflex, and descended almost by its own weight. A trial meal was administered, and expressed one hour after ingestion. The stomach contents showed the presence of traces of free hydrochloric acid and of a large amount of lactic acid or lactates. This led me to prescribe large and frequent doses of the dilute hydrochloric acid. Peptonized milk and beef peptones were allowed in small quantities at short intervals, until the abatement of the acute symptoms warranted an increase of the nitrogenous diet. The carbohydrates were at first excluded and only very cautiously introduced into the daily regimen. Acting upon a hint from the patient as to his having always been benefited by a long tramp into the country, I advised him to purchase a bicycle by the use of which I intended to act more forcibly and directly upon the abdominal muscles, for a flabby abdomen is, undoubtedly, an important factor in bringing on permanent dilatation

of an already atonic stomach. The existence of some muscular insufficiency was suspected by me from the very beginning; that my suspicion was not groundless, was fully borne out by my further investigation. On this line of treatment, the patient gradually improved, and at present his health is restored to its usual equilibrium, which of course does not mean that the gastric insufficiency has been removed. The treatment did not affect Mr. D——'s ruminating propensities in any way; it was not intended to do so, for I followed, with regard to this feature of the case, the doctrine of letting well enough alone. I, of course, insisted all along, on a thorough primary mastication. Whether this will have ultimately the beneficial effect of eradicating the ruminating habit, remains to be seen; thus far no change is noticeable.

Having done my duty by my patient, I now called on him to do his by me, to which call he most graciously responded. On March 24, I subjected him to another physical examination, with the following results: Inspection, palpation and percussion revealed nothing of any moment. On auscultation, with the stethoscope placed below the xyphoid cartilage, Metzer's "Durchspritzgeraeusch" (Ewald's 1st deglutition murmur), was audible once out of four times, the "Durchpressgeraeusch" (Ewald's 2nd deglutition murmur) was perceptible three times out of four, *i. e.*, when the first could not be heard.

Two hundred and fifty cubic centimeters of water were poured into the stomach by means of the tube; in

the standing posture a line of dullness appeared 4 cm. over the umbilicus. The addition of 500 cc. brought the line of dullness to within 2.5 cm. of the umbilicus. The patient complained of a sensation of fullness, and the stomach was emptied. After this, distention with air was attempted. At every stroke of the double-bulb apparatus, the air rushed out along the sides of the tube, with an explosive sound. This fact and the great discomfort complained of by the patient caused me to desist from any further attempt at distention.

Thus far my examination proved to me three points.

1. The absence of any considerable degree of gastrectasis.

2. The high degree of paresis or insufficiency of the cardiac sphincter.

3. Some muscular atony of the whole organ.

To establish the degree of motility of the stomach, Ewald and Sievers' salol test was made use of:

March 25, the salicyluric acid reaction was obtained two hours after ingestion.

March 31, the reaction appeared two hours after ingestion and failed to show twenty-four and thirty-two hours after.

April 8, traces of the acid were demonstrable in the urine passed two and sixteen hours after ingestion; no acid was found in the urine passed twenty-four and thirty hours after ingestion.

The last dose of the salol was taken during a meal consisting of boiled chicken, farina egg pudding and a glass of dilute white wine. The patient was at my

office three hours five minutes after this meal. As he spoke of experiencing a sensation of gastric fullness, I expressed the stomach and found the contents strongly impregnated with the characteristic salol odor. In giving the results of this test, due reservation is made for the possible fallacies pointed out by some observers, and admitted by Dr. Ewald himself.[1]

To test the absorptive power of my patient's stomach, I followed Penzoldt's suggestion, *i. e*, giving 0.1 gram of potassium iodide, and timing its appearance in the saliva.

March 25, it appeared one hour, and one hour and fifteen minutes after ingestion.

March 31, it had not appeared after one hour and thirty minutes.

April 8, it appeared after one hour and fifteen minutes.

I give these results with some misgivings as my patient's ruminating faculty renders them unreliable; the saliva may have been contaminated by regurgitated food particles carrying with them some of the iodide.

The method pursued in the investigation of the digestive chemism was the following:

Having ascertained that no acid of any kind had been taken for at least sixteen hours, Ewald's test breakfast consisting of thirty-five grams of dry white bread, and one-third of a liter of warm water, was administered on an empty stomach, and the latter expressed one hour afterward. The expressa were filtered, the residue weighed, the filtrate measured and subjected to an

analysis. For the sake of simplicity, I place the conditions or substances tested for, in juxtaposition to the reagents or tests employed:

Reaction = litmus paper.

Free acid = tropaeolin solution.

Lactates, lactic and fatty acids = Uffelmann's reagent.

Acetic acid = by its odor.

Acid salts = Leo's method.

Free hydrochloric acid = Guenzburg's reagent.

Total acidity = titration with an empirical potassium hydroxide solution (1 cc = 0.002532 g. hydrochloric acid), the potassium hydroxide having been previously purified by the Barium method. Phenol Phtallein was used as indicator.

Bile = Gmelin's test.

Starch and Erythrodextrin = Lugol's solution.

Maltose = Copper reduction test.

Thus far, the examination was conducted pretty much on lines laid out in Dr. Ewald's treatise on Diseases of the Digestive Tract. With regard to the manner of ascertaining the presence of the different proteid substances in the stomach contents, I deviated from the course advocated and commended by the professor of Berlin. On pages 42 and 43 of the authorized American edition (1892),and on pages 59, 60 and 61 of the third German edition (1893), appears a statement reiterated three times in rapid succession, to the effect that syntonin when present in the stomach contents in solution is coagulable by heat. This is a gross error as syntonin

and all of the other so-called derived albumins and albuminates possess the indisputable properties of being insoluble in water, salt solutions and alcohol but soluble in dilute acids or alkalies, of not being coagulated while in solution at any temperature whatever, be it 70° or 212°, and finally of being precipitable by careful neutralization. The neutralization-precipitate (Mulder's protein ?) is indeed coagulable at 70°, when suspended in water or any other neutral medium.

The method which I have adopted for separating the different members belonging to the family of proteids, is the following:

1. Boil the filtered stomach contents.

Turbidity shows the presence of native proteids (albumins, globulins).

Filter.

2. Test the reaction of the filtrate with litmus paper; if acid, neutralize exactly, using as indicator, litmus or turmeric paper. (To avoid an excess of the neutralizing reagent, it is best to use normal or empirical sodium carbonate solution, the total acidity for a certain quantity of stomach contents, having been estimated previously by titration).

A precipitate indicates acid albumin.

Boil and filter.

3. Test filtrate for the cuproproteic reaction.

If a rose-red coloration appears, add a few drops of acetic acid, and to the almost boiling filtrate from 2, add solid ammonium sulphate to saturation (97.5 parts of the salt to 100 parts of stomach contents).

A precipitate proves presence of albumoses.

Filter after twenty-four hours.

4. Test filtrate for cupro proteic reaction:

If a rose-red coloration appears, crystallize out some of the ammonium sulphate, and filter. If with nitric acid a yellow coloration, and with ferrocyanide of potassium and acetic acid no precipitate is obtained, the presence of peptones is proved.

I call attention to the following points in this scheme:

The stomach contents are boiled at once after expression and filtration, so as to destroy the action of the gastric enzyme.

In testing for derived albumins, the use of an indicator in solution is not advisable on account of the color reactions to be made subsequently.

The term acid albumin is substituted for syntonin as used by Ewald. The latter term is reserved by the majority of physiologists and chemists for the substance formed by the action of dilute acids on muscle myosin (Hermann,[2] Gad and Heymans,[3] Steiner,[4] Landois and Stirling,[5] Foster,[6] Roehmann,[7] Beilstein[8]). We may well retain "acid albumin" for a generic term.

The filtrate from 2 is boiled so as to throw out any egg albumin that might not have been coagulated by the first heating on account of the presence of the acid.

For the cupro-proteic reaction, Wenz[9] recommends the use of a 15 per cent sodium hydroxide solution, and a 0.2–0.5 per cent cupric sulphate solution added drop by drop. I prefer not to name the rose-red cupro-proteic reaction a "Biuret" reaction for the reason that

a lamentable confusion exists with regard to this term: some physiologists apply it to the violet and rose-red cupro-proteic reactions, others limiting it to the latter. Biuret is a nitrogenous decomposition product obtained on heating urea to 120°. It responds to many reactions characteristic to proteid bodies, hence Pickering[10] recommends the use of the term "Biuret" in a generic sense. He offers at the same time new terms for the two cupro proteic reactions: for the violet—"iono-proteic" (from the Greek—a violet), and "rhodo-proteic" for the rose-red reaction (from the Greek—a rose). The popularization of this proposed change should be hailed with gratification by all who have truly scientific terminology at heart. In quoting Pickering I take pleasure in mentioning his recommendation of the sulphate of cobalt as a delicate reagent for detection of proteid bodies. The colors struck by it with the different proteid bodies are so characteristic as to preclude any possible error of discernment, while that much cannot be said of the violet and rose red of the cupro-proteic reaction.

For the separation of the albumoses of which Ewald in his scheme mentions but one, the propeptone of Schmidt-Muehlheim, or Kuehne's protoalbumose, I modified Ewald's procedure by substituting saturation with ammonium sulphate for the saturation with sodic chloride on addition of acetic acid. Wenz[11] has satisfactorily demonstrated that ammonium sulphate, under certain conditions, will throw down all proteids except the true peptones. Ewald follows the method recom-

mended by Boas, the results of which Chittenden[12] has proved to be without any value for the reason that sodic chloride will precipitate protoalbumose, but will not affect in the least the deuteroalbumose. The latter would pass into the filtrate from 3, and thus vitiate the results of the subsequent tests for peptones.[13]

Reverting to the case under consideration, I will state that Ewald's test breakfast was administered on six different occasions. The expressa obtained on March 27 were rejected on account of a distinct odor of sulphuretted hydrogen, the presence of which would have vitiated Guenzburg's reaction and the results of the estimation of total acidity. The patient admitted having eaten some eggs on the previous day which may have been not quite fresh. It has been urged by Vierordt[14] and others that Ewald's trial meal left room for considerable error by putting the working capacity of the stomach to but a slight test. To meet any objections on that score, I added to the breakfast in Exp. VII and VIII the white of two hard boiled eggs.

The results of the analysis were as follows:

	Mar. 25	Mar. 27	Mar. 29	Mar. 31	April 1	April 4	April 17	April 22	
Exp.....	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	
Residue.....	5 99		4.51	3.85	6.73	5.20	3.82	6.90	grms
Filtrate	46		36	47	36	42	46.5	52	cc.
Reaction	acid		acid	acid.	acid	acid	acid	acid	
Free acid.....	pres.		pres.	pres.	pres.	pres.	pres.	pres.	
Lactic and fatty acids.....	abs		abs	abs.	abs.	abs.	abs	abs.	
Acetic acid.....	abs		abs.	abs.	abs.	abs.	abs.	abs.	
Acid salts.....	trace		trace	abs.	abs.	abs.	abs	abs.	
Free hydrochloric acid..	2.203		1.499	1.694	1.418	1.747	1.514	1.932	p m.
Starch	pres.		abs.	abs	abs	abs.	abs.	abs.	
Erythrodextrin.	pres.		pres.	pres.	pres.	pres.	abs.	abs.	
Maltose.....	pres.		pres.	pres.	pres.	pres.	abs.	pres.	
Native proteids.	abs		abs.	abs.	pres.	pres.	pres.	pres.	
Acid albumin...	abs.		pres.	pres.	pres	pres.	pres.	pres.	
Albumoses.....	abs.		abs.	abs.	?	pres	pres.	pres.	
Peptones.....	pres.		pres.	abs.	?	?	pres.	abs.	
Bile.....	abs.		abs.	pres.	abs.	abs.	abs.	abs.	

The residue consisted of bread pulp; no coagulated egg albumin was discoverable in the expressa obtained for Exp. VII and VIII.

The filtrate was watery, slightly opalescent, odorless or of a faint bread odor, in color yellowish, except faintly greenish-yellow in Exp. IV.

The salient points in this list of experimental data appear to be the following:

1. The rather close approximation of the amounts of residue and filtrate obtained at each experiment points to the thoroughness of the expression practiced.

2. The absence of any fermentative process is evident.

3. The amounts of free hydrochloric acid estimated, lie within the limits of the physiological norm, the minimum being 1.418 and the maximum 2.203 p. m. The nitrogenous addition in Exp. VII and VIII, did not affect the amount of the free acid.

4. The amylolytic action of the salivary enzyme is demonstrated by the presence of erythrodextrin and of maltose, the latter in considerable quantities in Exp. I–VI as shown by the exceedingly vigorous reduction of the cupric oxide. In VII, no reduction took place, and in VIII, but a slight one.

5. In the light of our present knowledge of gastric digestion, the analysis of the changes produced by the action of the pepsin-hydrochloric acid, is of but small value as clinical evidence. At the very threshold, we are met with a veritable maze of questions: Does gastric proteolysis terminate normally in the production

of true peptones? The albumoses being more closely related in molecular composition to the intravascular proteids than the peptones, are they absorbed to any extent by the mucous surface of the stomach? Does the absorptive function of the stomach play an important or an insignificant role during the digestive processes? These and many more perplexing questions are awaiting a satisfactory, experimental solution. At present the clinician cannot be too cautious in drawing conclusions from the results obtained by an analysis of stomach contents. The trend of experimental evidence seems to point to but a slight absorptive power exercised by the stomach. If I accept this view, I am able to give but one interpretation to the data presented in the above table: the disappearance of a large amount of the ingesta (on the average about 30 grams out of 35) together with the presence of the proteolytic products in small quantities, points to a rather active removal of the stomach contents into the small intestine. This would go to show that the muscular insufficiency demonstrated by the physical examination is not of a pronounced character.

The intensity with which coagulated egg albumin is liquefied by my patient's gastric secretion, was tested according to the method described in detail by Ewald. The addition of hydrochloric acid, two drops to 5 cc. of stomach contents, exercised a favorable influence upon the process of liquefaction.

The chemical analysis proves clearly that the digestive chemism, in any and all of its phases, is not the

causal factor of the ruminating habit in the case under consideration.

Shall I shelve the difficulty by labelling this most remarkable phenomenon with the enigmatical superscription "neurosis?" To my understanding this euphonious term appears very nearly akin to the mathematician's zero: it *is* not "nothing," but it is the symbol for nothing I admit that we cannot entirely dispense with the term, as the dislike for nameless things is an inherent quality of our nature. What I object to, is the assumption of an oracular mien while giving utterance to it, just as if something intelligible and tangible were implied by its use. The neuroses are the offspring of our limitations. As a temporary makeshift, the term may serve its purpose, but let us hope that with further development of our means of investigation, the neuroses will gradually decrease in number, and at last disappear entirely from the field of our intellectual vision. To me merycism is not a neurosis, but what is it?

The great majority of merycoles were reported as enjoying perfect health; except for this habit, they did not disclose any deviation from the physiological standard. In my case there is seemingly a primary muscular insufficiency of the stomach, which appears to be a product of prenatal influences, a baleful legacy of a line of ancestors afflicted with a weak digestive viscus. To prove or disprove by actual data the existence of these influences is alike impossible, as we are rarely allowed to lift the veil off the past, beyond the second generation of progenitors. Few women or men know any-

thing about the physical condition and habits of their great grandparents, though they may be found brimful of information as to the social, intellectual and, perhaps, moral status of their ancestry, centuries back. Does the paresis of the cardiac sphincter or the atony of the entire organ stand in any causal relation to my patient's habit? The former, as we all know, gives rise frequently to repeated and very persistent regurgitations of food. But rumination is something more than regurgitation; whenever the latter takes place, any of the stomach contents present at the time are sent up indiscriminately: at one time it may be solid food, at another chyme, or gas or fluid. In the case before us, the regurgitating act occurs with plainly selective precision; only, portions of the food that are in need of further mastication are returned with almost marvelous regularity. This feature stamps the case as one of rumination. The general atony of the organ cannot be considered seriously as a causal factor, for rumination is an act calling for actual, though perhaps slight exertion on the part of the muscular fibers of the stomach, the extrinsic abdominal muscles being never called upon to aid in the consummation of the act.

My attempts at solving the problem having failed thus far, there is but one more thing to be done, and that is to find how much or how little the process of atavic tendency or reversion to ancestral types may have had to do with the establishment of this unusual condition. Eugene Martel,[15] in a contribution to the *Revue Internationale des Sciences Medicales*, (1886),

quoting Blanchard, says, "that the habit of rumination was acquired by certain animals at the time that the carnivora appeared upon the earth. Fearful of attack, the ruminants grazed rapidly, ready for flight at the first intimation of danger. Then, having reached a place of safety, their food was regurgitated and masticated thoroughly. A similar condition is obtaining in man, he asserts, in this age of hurry; and unless we learn to be more deliberate in our eating, and to masticate our food in the first instance more carefully, the necessities of digestion will compel a regurgitation and rechewing of the food, which has been so imperfectly prepared for the action upon it of the gastric and intestinal secretions, and in time this process which is now exceptional in man, will become habitual."

This is not fanciful in the light of the science of evolution. While we are busily working in our laboratories over flasks and test tubes, pressing into service all the innumerable devices of human ingenuity, with a view of revealing some truth, we should never grow oblivious to the work that is being done in the great universal laboratory where in accordance with the eternal laws of nature changes are wrought unceasingly, unremittingly. These changes are effected by a slow gradual process, the actual workings of which remain ever imperceptible to us. Our intellect is capable of grasping their enormity only in the retrospect. But, if on the highroad of our natural lives, we meet with a phenomenon that appears to be replete with incongruity with its surroundings, and to defy our attempts at ex-

planation, made in accordance with our limited experiences, do not let us dismiss its consideration lightly! It may easily be one of those sudden flashes by which Nature reveals her cosmic work from time to time. It will not do to refuse such thoughts entrance into the routine of our daily labors. If we disdain to apply the grand lessons taught by the science of biological evolution, we shall continue to dwell in utter darkness with regard to many vital phenomena. The laws of evolution, though all of their mysteries have not been and may never be unraveled, have been long ago cleared of the odium of idle speculation; they are as much of an incontrovertible fact as the law of gravitation.

Here we are face to face with a man who clearly abused his stomach, which, at his very birth, was branded with ancestral vice. Food which is the natural stimulant to the sensitive mucous membrane of the organ, was bolted, practically unchewed, every day of his life. From being a stimulant when offered in proper form, it grew to be an irritant, the difference lying in degree only, not in kind. The presence of irritating agents of any description is angrily resented by all tissues of high vitality: the mechanically indigestible matter was promptly rejected. This marks the phase of regurgitation. The possessor of the stomach finding the regurgitated bolus unaltered in flavor, *i. e.*, not objectionable to his palate, subjected it to more thorough mastication. This interchanging play was repeated until the food had attained the pulpy consistency best suited for the work of digestion. This marks the

phase of rumination. The bolted gross food particles gradually ceased to play the role of irritating agencies; habitual recurrence of the events, made them revert to their original character, *i. e.*, they again became stimu lants with the only difference that instead of inciting the churning movements of the stomach, they called forth propulsive movements that carried the offending agents along the path of least resistance, namely through the cardiac opening with its paretic sphincter. It is reasonable to assume that the nerve elements, central as well as local, acquired, pari passu, the faculty of responding to these new agencies of stimulation, and thus a complete reflex mechanism had been established. The higher brain centers were at first actively engaged in directing the process of remastication. At last they grew habituated to the changed order of things, and the entire act lost all the features essential to a conscious effort.

Thus stands before us in bold relief a beautiful illustration of the workings of atavic tendency. Our merycole bears out the biological truism that similar conditions are ever productive of similar effects, and that every living organism possesses the inherent power of adaptation. Two points may be raised against the view taken by me: firstly, it may be argued that the insignificant number of cases observed and recorded (about 116 in all, I believe) does not warrant such conclusions as I choose to draw from them; secondly, that there never were any profound anatomical changes demonstrated, which would lend strength to the assumption that

merycoles were products of the latent tendency to revert to ancestral types. As to the first objection, let me ask how are we to know that the small number of cases reported represents even approximately the actual number that have existed and exist at the present day? Might we not justly surmise, from the very nature of the phenomenon, that an untold number of merycoles have lived and still live their long and natural lives amidst the mass of teeming humanity without ever having awakened to the consciousness of deviating in any manner from the physiological norm?[16] Raphael Blanchard,[17] who is a congenital merycole, is a good case in illustration. The peculiarity of his condition never dawned upon him until a text book of human physiology had come into his hands; but for that incident, his case might never have been placed on record. The other objection I will meet by adducing the biological fact that physiological or functional changes always precede those of an anatomical or structural nature. Thus were the semi-carnivorous incisor and canine teeth of the Artiodaktyla and Perissodaktyla subjected to gradual structural changes, after the animals had begun to feed on food of a different nature. The close relationship between structural arrangement and functional requirement is beautifully illustrated by the stomach formation of the new born of the Selenodonta or Ruminantia, now extant.[18] Instead of the four compartments that we find in the adult animal there is but one fully developed, and that is the abomasus with its enzyme secreting mucous surface; the rumen, reticulum and omasus attain

their full development during the first period of the animal's extra uterine life. Our domestic calf does not ruminate while suckling. The mechanism of rumination is set to going at once when the nature of the food is changed. If merycoles have not so far borne out anatomically the theory of atavism, that does not preclude the possibility of gradual structural adaptation to the altered functional requirements. It must never be lost sight of that all evolutionary transformations, be they progressive or revertive in nature, are extremely gradual, and that we should not measure evolutionary processes with the infinitesimal measure of the few thousand years of historical record. We should remember that eons of time lay behind us, and that eons are to come!

In conclusion I will say that—atavism or no atavism—human rumination, if genuine, is not a pathological entity, but a physiological anomaly. It appears anomalous by comparison with the habits of the great bulk of non ruminating members of the human family. With most merycoles it assumes the form of a perfectly natural process, essential to their individual well being, any interference with which is frequently followed by disturbances of a truly pathological nature. I frankly confess to sharing fully Eugene Martel's view, which appears rational in the light of many other manifestations of Nature's willing responsiveness to use, abuse and disuse.

I have advisedly refrained from all bibliographical and historical annotations on the subject of human

rumination. I refer those interested in the phenomenon to Ewald's *Klinik der Verdauungs krankheiten*, Band II.: Einhorn's article on "Rumination in Man," *Medical Record*, 1890; Stedman's "Rumination in Man," Reference Handbook of the Medical Sciences, Vol. VIII.

The chemical work, in connection with this report, was done at the physiological laboratory of the St. Louis Medical College.

I take pleasure in thanking Dr. John Green, of the faculty, for the encouragement he has given me by word and deed, encouragement he is always ready to proffer whenever and wherever earnest work is being done.

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[1]Whoever has done any work in the physiologico-chemical line, will appreciate the importance of acute discernment of different tints and hues, for much of the accuracy in this work depends upon the possession of that faculty. For the benefit of the inexperienced in that special work, I mention the occurrence of an optical phenomenon in connection with the salol test. The color of a drop of Ferric chloride solution, appears on white filter paper, a greenish-yellow which has for its complement "violet." The latter appears very quickly on retinal exhaustion for the greenish-yellow. As the crucial test for the salicyluric acid, is the appearance of a (usually faint) violet color, the possibility of an error is obvious. My advice is to either trust to the first quick glance, or to repeat the test upon complete disappearance of the negative after-image.

[2]Hermann, Lehrbuch der Physiologie, 1892.

[3]Gad and Heymans, Kurzes Lehrbuch der Physiologie des Menchen, 1892.

[4]Steiner, Grundriss der Physiologie des Menchen, 1890.

[5]Landois and Stirling, Textbook of Human Physiology, 1886.

[6]Foster, Textbook of Physiology, 1891.

[7]Roehmann, Anleitung zum Chemischen Arbeiten, 1890.

[8]Beilstein, Handbuch der Organischen Chemie, 1890.

[9]Wenz, Zeitschrift f. Biologie, Band XXII.

[10]Pickering, "Proteid Reactions," Journal of Physiology, Vol. XIV, 1893.

[11]Loc. cit.

[12]Chittenden and Hartwell, "Proteoses and Peptones," Journal of Physiology, Vol. XII, 1891.

[13]Kuehne has recently pointed out that complete precipitation of the deuteralbumoses can only be attained upon long continued boiling of the fluid saturated with ammonium sulphate, and then only when the reaction of the fluid is changed alternately to neutral, alkaline and acid, the heating of the fluid being continued for some time between these changes. He also recommends treatment with saturated sodium chloride solution previous to entering on the ammonium sulphate process. (Zeitschrift f. Biologie, Band XXIX).

[14]Vierordt, Diagnostik der Inneren Krankheiten, 1889

[15]Stedman, "Article on Rumination," Reference Hankbook of the Medical Sciences, Vol. VIII.

[16]The strong plausibility of this assumption has been forcibly impressed upon my mind since the reading of this report. A gentleman of high scientific repute, upon hearing of my case, volunteered the information that he had been a merycole for a long time. His case has never been recorded.

[17]Stedman, "Article on Rumination," Reference Handbook of tne Medical Sciences, Vol. VIII.

[18]Wiedersheim, Lehrbuch der Vergleichenden Anatomie der Wirbelthiere, 1886.