in each of two families; and in one household there were six cases. Multiple or secondary cases occurred in 6.21 per cent of the cases in the series. This rate compares closely with the attack rate of 6.1 per cent that occurred among the hospital personnel, who were more or less in close contact with the clinical cases.

Consequently, it is my opinion that direct contact, especially if associated with prolonged exposure, lack of opportunity to develop subclinical immunity by repeated small contact doses, fatigue, loss of sleep, and the constitutional make-up of the individual, all play a very important rôle as to whether an individual actually develops poliomyelitis or becomes subclinically immune. Surely, the spread can be controlled to some degree by the isolation of the patient and the restriction of the contacts. By so doing, we will help to prevent overwhelming exposure doses to many susceptible individuals, giving them a chance to build up protection by subclinical means.

Until confronted with more knowledge in regard to the spread of the disease, we are willing to accept the now prevailing opinion that it is spread by droplet infection from those ill with the disease, and often by carriers, who have themselves developed subclinical immunity.

I am in accord with Doctor Geiger's emphasis on the establishment of diagnostic centers for the early diagnosis and hospitalization of suspected cases. The use of nasal sprays can only be of limited usefulness. It has its drawbacks and dangers at the present time and, under these circumstances, cannot be of practical aid in the field of public health. I believe that the hope of the future for the control of poliomyelitis still lies in the development of a safe and efficient vaccine.

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E. B. SHAW, M.D. (384 Post Street, San Francisco).—It must be admitted by any student of epidemiology that quarantine is frequently a process of closing the door after the horse is out, and is only justified by the argument that there may be other horses. In poliomyelitis, as in most infections, clinical diagnosis is established only after the patient has, in all probability, passed through his period of greatest communicability and, doubtless, thereafter continues to be a potential disseminator of virus but, due to the fact that he is then an ill child, the opportunities for dissemination are considerably cut down and he is not nearly so dangerous to the community as he was for a short time before the development of active symptoms. Doctor Geiger's observations indicate that, while the patient with poliomyelitis is not demonstrably a frequent source of other cases, the infection chain in this disease is, however, most obscure; and cases intermediate between a pure carrier state and outspoken paralytic forms of the disease are a likely agency for distributing the infection to the population. These disseminators of the infection are not readily detectable by ordinary methods, they are not clinically recognizable, and the virus cannot be demonstrated in their secretions with the ease with which diphtheria bacilli may be detected.

It is not altogether rare, however, as even Doctor Geiger's series demonstrates, to find the disease developing after contact with a known clinical case. Without completely reviewing the cases of poliomyelitis which I have seen, I can quickly recall several instances: (1) three children in one family developed the disease at intervals of four or five days; (2) a four-year-old child was exposed to a patient in another town, and developed the disease five days later; (3) at least three of the mothers who cared for small children during the early stage of the disease developed poliomyelitis within a week following their first exposure; (4) a child intimately exposed to her sister, who died of the bulbar form, developed poliomyelitis twelve days later with an almost identical clinical picture. I believe that these instances could be multiplied by a careful study of the intimate history of many cases. It has always been my belief that, although numerous individuals may be exposed to this disease without contracting it, intimate exposure is not necessary for the infection of the patient whose susceptibility is modified by constitutional and environmental factors which predispose him to infection. I suspect that the disease passes from one patient to another by means of an infection chain which includes the clinical case, the subclinical case, and perhaps even includes the healthy carrier.

Dissemination of the virus throughout the community is only a single factor in the production of epidemics; there are many reasons to suspect that numerous environmental factors must be propitious before an epidemic can develop. Until these environmental factors are more precisely known there is little which can be done from a public health standpoint, except to make an effort to reduce dissemination of the infectious agent, and this can only be partially secured through the isolation of cases and contacts. During seasons of increased epidemicity, when presumably environmental factors favor the disease, it is especially desirable to make every effort to avoid scattering infection, even though demonstrable case-to-case connections are not evident.

Doctor Geiger's observations emphasize simply the obscurity of our state of knowledge regarding the precise epidemiology of poliomyelitis. It might be relatively safe to enforce *no* isolation for the affected individual, but even a small degree of risk is incompatible with the nature of the disease, and the fear which it engenders in any community. St. Paul was responsible for the advice, "To abstain from the appearance of evil." This may not be valid epidemiology, but it is sound public health, from which I do not believe Doctor Geiger would propose any departure. There is no doubt that the study of epidemics from the standpoint of public health deserves the earnest coöperation of the clinician, who alone can supply a wealth of intimate detail regarding the individual patients helping to comprise the epidemic.

FUNCTIONAL INDIGESTION *

By ALFRED E. KOEHLER, M.D.
Santa Barbara

DISCUSSION *by William C. Boeck, M.D., Los Angeles; T. L. Althausen, M.D., San Francisco; Hugh Freidel, M.D., Santa Barbara.*

FUNCTIONAL indigestion may be defined as a disturbance of the digestive and assimilative functions in which no organic pathology can be demonstrated. Although many factors influence alimentation, in general well-masticated food undergoes proper digestion when (1) an adequate amount of the various digestive secretions is available; (2) when gastro-intestinal motility is neither excessively slow nor fast; and (3) when absorption of the products of digestion or of the simpler foodstuffs by the blood stream or by the lymphatics is adequate. By adequate in this respect, we mean that unabsorbed foodstuffs do not reach the colon or if so, only in relatively small amounts.

It is, of course, altogether probable that digestive disturbances due to organic causes, such as peptic ulcer or cholelithiasis, are related reflexly to these same factors. Removal of the organic lesion usually clears up the disturbance, and little thought is ordinarily given to the actual physiological mechanism involved.

In this study we have confined ourselves purely to those cases in which organic pathology has been ruled out as far as possible. The error is frequently made of assuming a functional diagnosis without eliminating such factors as ulcers, gall-bladder and liver disease, constriction, adhesions, diverticulae or congenital malformations. Failure of proper roentgenographical studies frequently is due to economic considerations, but experience teaches us that such economy is usually expensive in the end. We

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Read before the General Medicine Section of the California Medical Association at the sixty-sixth annual session, Del Monte, May 2–6, 1937.

TABLE 1.—*Limits of Variation Into Which 90 Per Cent of Normal Cases Fell*

Rate of flow	0.8 to 1.6 cubic centimeters per minute
Icteric index	25 to 60 times dilution
Amylase	200 to 500 milligrams sugar
Lipase	18 to 25 cubic centimeters 0.1 N NaOH
Protease	4.0 to 6.0 milligrams amino nitrogen

strongly urge that indigestion of any prolonged duration be not assumed as functional, but that every effort be made to rule out organic disease.

However, after such pathology is ruled out as far as possible, a considerable group remains that must be classified as functional disorders.

PLAN OF STUDY

Our approach to this problem, which too commonly is handled in a vague and purely symptomatic fashion, has been through channels of objective and quantitative diagnostic studies concerning digestive secretions, motility, and absorption. The latter two factors are, of course, intimately related, and dissociation, at least for the time being, has been difficult.

DIGESTIVE SECRETIONS

By means of a duodenal tube and a modified technique we have studied the duodenal secretions under basal conditions in 38 normal, 280 abnormal, but without digestive disturbances (malnutrition, adiposity, diabetes, allergy, etc.), and 710 cases of indigestion. Such studies have been reported previously by various workers, with the general conclusion that little value can be attributed to such findings. It is our belief that such failures have been due to: inadequate standardization of the drainage technique, poor methods of analysis, inconclusive data on the normal limits of variation, and failure to obtain more than one drainage in questionable cases.

The drainage material was analyzed immediately after it was obtained. The digestions were done at 37.5 degrees centigrade, in a special type of incubator in which a shaking platform kept the mixtures in constant gentle agitation. The digestions were all carried out in a phosphate buffered solution at pH 7.0 (the probable average pH of the contents of the small intestinal tract) and expressed in the following manner:

Rate of Secretion. Expressed as cc. collected per minute.

Icteric index (bile pigments). Dilution of drainage necessary to match colorimetrically 0.01 N potassium dichromate solution.

Amylase. Mg. sugar as maltose liberated from 1 cc. of 1 per cent starch solution by 1.0 cc. secretion in 10 minutes at 37.5° C.

Lipase. Cc. of 0.1 N NaOH required to neutralize the fatty acids formed from 2 cc. olive oil by 10 cc. secretion shaken (emulsified) in an incubator for three hours at 37.5° C.

Protease. Mg. of amino-acid + NH_3 nitrogen obtained from 250 mg. casein by 10 cc. secretion shaken in incubator for three hours at 37.5° C.

Table 1 shows the limits of variation of 90 per cent of the normal cases, while Table 2 shows the incidence of abnormal findings in the indigestion cases. We believe that the figures for decreased rate of flow, bile pigments and amylase in indigestion are significantly outside the values for normal variation, while those for lipase and protease are only questionably so. On the other hand, it is also well shown that a considerable percentage of the indigestion group have drainage values well within the normal variation limits, and that the cause for indigestion in these cases must be sought for in abnormalities other than digestive secretion deficiencies in the upper duodenum. Insufficiency of digestive secretions in the jejunum and ileum (succus entericus; erepsin, sucrase, lactase, etc.), has never been adequately studied.

TABLE 2.—*Incidence of Abnormal Findings in 305 Cases of Indigestion*

	Per Cent Below Lower Range of Normal Variations
Rate of flow	29
Icteric index	47
Amylase	26
Lipase	13
Protease	17

STARCH INTOLERANCE

The high frequency of starch intolerance, as cited by patients in obtaining their histories, and the high percentage of amylase deficiency in the duodenal drainages made it desirable to devise a further quantitative test for this difficulty. This we accomplish by giving 1.5 gram of cornstarch suspended in water per kilo body weight in the same manner as for the glucose tolerance test and determining the glucose absorbed in the blood during hour intervals. In the normal person there is an excessive amount of amylase available, so that the rate of absorption of the sugar formed becomes the limiting factor and, consequently, the blood sugar curve after starch is similar to that after glucose. In many cases of indigestion, however, the blood glucose curve after starch is greatly flattened, frequently no elevation at all being noted. Commonly, such cases have nausea, flatus, distention, occasionally headaches and general malaise six to twelve hours after the starch ingestion, due probably to the undigested starch reaching the colon and undergoing rapid fermentation. Chart 1 shows the comparison of starch and glucose tolerance curves in a normal and a case of starch indigestion.

SIMPLE SUGAR INTOLERANCE

A considerable number of cases give the history of not tolerating simple sweets. Frequently, such small amounts of sugars (10 to 15 grams) caused upsets when administered in a test-meal, even when disguised, that the question of allergic intolerance was raised, but this was felt to be improbable because large amounts of these same sugars (sucrose, lactose, xylose and glucose) given intravenously to these patients produced no disturbances. In the case of glucose intolerance the factor of digestion

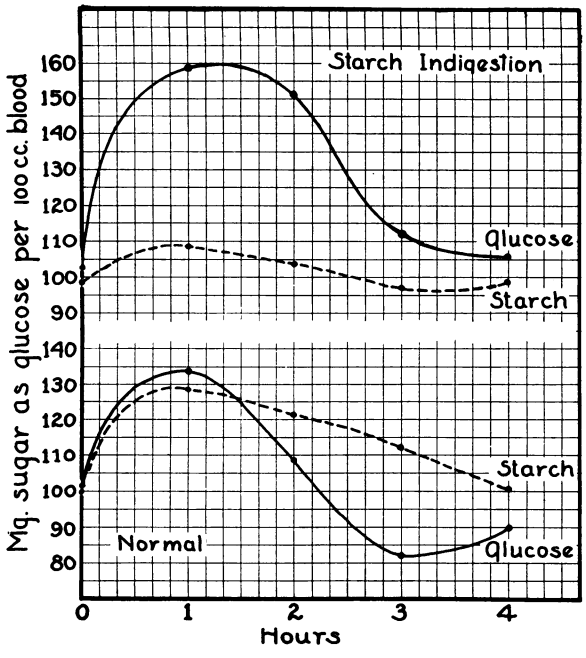

Chart 1.—Demonstration of failure of blood sugar rise after starch ingestion in a case of indigestion as compared with the normal rise in blood sugar after the same amount of glucose.

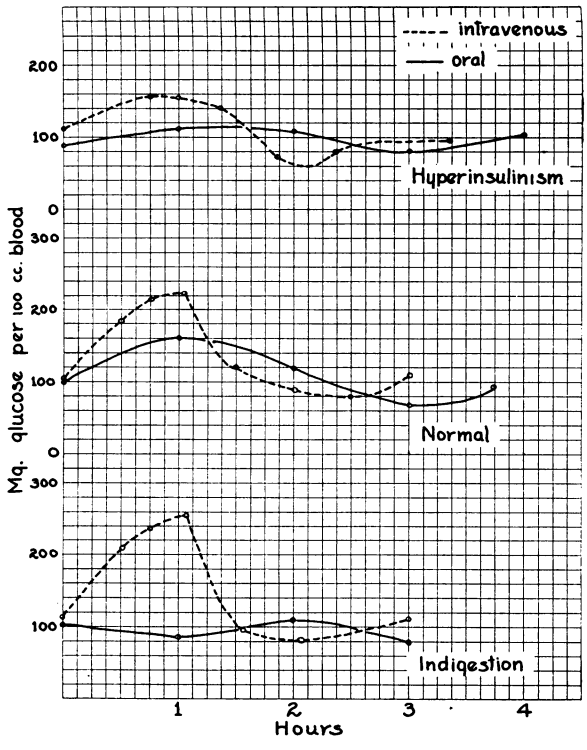

Chart 2.—Demonstration that the flat blood sugar curve after glucose ingestion may be due to failure of absorption. Such flat curves may be differentiated from those of hyperinsulinism by the intravenous administration of glucose.

can be eliminated, and consequently we turned our attention to its rate of absorption. Glucose tolerance tests by mouth in this type of a case frequently show only slight or no rise of the blood sugar afterward. Such a flat curve, of course, could be due either to faulty absorption from the intestinal lumen or to excessively rapid utilization of the sugar after absorption such as is obtained in cases of hyperinsulinism. That the latter was not always the case and that, consequently, the flat curve was due to poor absorption, was proved by demonstrating a normal or even poor utilization tolerance by continuous intravenous injection of glucose at a constant rate.

The distress that these people, with impaired glucose absorption, have after sugar ingestion is similar to that mentioned under starch indigestion.

Chart 2 gives examples of oral and intravenous glucose tolerance curves in normal, hyperinsulinism and sugar intolerance cases.

As to the type of disorder responsible for decreased sugar absorption, little is known. The possibility exists that decreased absorption is due to increased intestinal rate, and that there is a comparable decrease in the absorption of other substances such as amino-acids as well.

TREATMENT

It should be emphasized, of course, that many other factors exist that cause or are related to indigestion than those included in our discussion. Among these may be mentioned allergy and less specific food intolerance, such as that produced by cooked cabbage, lettuce, radishes, etc. We purposely avoid discussion of the vague term *nervous indigestion*; not that nervous disturbances are not important, in fact they are of fundamental importance, as has frequently been shown by various workers, but we prefer to think in terms of the type of alimentary disturbance caused by aberrant nervous activity.

Our experience leads us to believe that an excessively rapid, small intestinal rate is the most common cause of functional indigestion, and that distress is caused by an excessive amount of bacterial food reaching the colon. Treatment consists of the well-known methods, avoidance of foods mechanically or chemically irritating, and nervous stabilization. This latter aspect is a problem of such magnitude that no attempt can be made to review it here. One point in regard to nervous irritability we do wish to emphasize, namely, malnutrition, frequently a result of indigestion or imposed dietary restrictions. We emphasize, in this respect, a well-balanced dietary regimen, with particular attention paid to the mineral and vitamin requirement, frequently augmenting the diet with the pure forms, especially calcium and vitamins B^1 and C.

TREATMENT OF PATIENTS WITH DIGESTIVE SECRETION DEFICIENCY

Motility is, of course, closely related to secretory deficiency, inasmuch as a fast rate greatly decreases the time of action of the enzymes on the substrate.

In general, secretory deficiency can be treated in one of three ways or combinations of these procedures:

1. If the deficiency prevents proper utilization of one of the food groups, this group may be materially reduced in the diet. For example, cases frequently are low in amylase but have adequate lipase and protease, and consequently are given a diet

low in starch and higher in protein and fat. Similarly the avoidance of more than the minimum of sugars greatly benefits cases that have poor absorptive ability.

2. The deficiencies may be substituted for by enzyme concentrates such as diastase, malt, and pancreatic preparations. The difficulty seems to be that the activity of these preparations is so low and irregular that efficient concentrations in the intestinal tract are hard to obtain. We are convinced that unprotected pancreatic amylase is completely destroyed by the gastric acidity. We have not been able to alter low starch tolerance curves with the most active amylolytic preparations available, even when enteric coated. On the other hand, many patients report general digestive improvement with these preparations, but such criteria is frequently difficult to evaluate.

3. The low secretory activity of the digestive glands may be stimulated, at least in certain cases. Food itself is probably the best stimulus, and low secretory activity can frequently be related to long periods of partial starvation, frequently imposed to avoid digestive distress. Encouragement to eat adequately of the proper foodstuffs frequently is followed by improvement of the secretory functions with general improvement.

The secretory impairment is frequently related to low general metabolic activity, as in cases of hypothyroidism, and probably in anterior pituitary lobe deficiency of the lean type. Thyroid treatment is frequently effective.

Furthermore, evidence is accumulating that certain vitamin deficiencies, particularly B_1, result in impaired motor and secretory activity of the intestinal tract, and we believe that our data, although still in the experimental stage, indicates the usefulness of vitamin B^1 therapy in these types of cases.

Santa Barbara Cottage Hospital.

DISCUSSION

WILLIAM C. BOECK, M.D. (1919 Wilshire Boulevard, Los Angeles).—One must unhesitatingly commend Doctor Koehler for the industry which his research represents in the field of functional indigestion. It was motivated, no doubt, by a desire to learn whether or not there is some detectable physiological disturbance that may account for the digestive symptoms in that group of patients presenting no evidence of organic pathology.

The investigation seeks to show that in many of these patients the digestive disturbances may be based upon their inability to metabolize starch in a normal manner. The evidence that this exists is based upon the low or flat starch-tolerance curve obtained in many of such patients. This curve is interpreted to mean that much of the ingested starch is not digested and absorbed, but passes on into the colon, where it is acted upon by the bacteria; the fermentation produces gas, which results in the flatulence, distention, abdominal pain or distress, nervousness, etc., so commonly complained of by these persons.

I believe, however, that this finding, while it may prove to be a contributing factor, cannot be said to be established by this work, because this research only deals with pancreatic digestion, and the blood-sugar curve represents absorption over only four hours. This undoubtedly represents the maximum absorption from the digested starch, and that which probably occurs for the most part in the duodenum, jejunum, and upper ileum; but digestion and absorption may still continue on down in the ileum, and perhaps the colon, too. We would like to have evidence that undigested starch actually reaches the colon in large amounts. The intubation methods of Abbott, Karr and Miller of Philadelphia might be used to clarify this point.

As the author states, such important factors of malnutrition and undernutrition, and the nervous irritability so common in these patients must be considered in treating them. Too often these patients have practiced progressive food exclusion from their diet, with the result that a deficiency state may exist. The indigestion symptoms gradually disappear when the treatment is handled intelligently to include an adequate balanced diet and a proper evaluation of all other factors that may have had a part to play in the production of the digestive symptoms. This investigation deserves much credit as another step in the direction of explaining the probable origin of some of these symptoms.

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T. L. ALTHAUSEN, M.D. (University of California Hospital, San Francisco).—The subject of deficient action of digestive enzymes in the body is decidedly in need of quantitative study, and Doctor Koehler's work is a valuable step in this direction. It is reasonable, as the author states, that diminution of amylase in the duodenal fluid does not necessarily mean failure of starch hydrolysis, because normally an excess of amylase is present. Doctor Koehler very properly advocates further studies in the nature of a starch meal, and if necessary a test of glucose tolerance by the intravenous method before the existence of improper splitting of starches is seriously considered. Even then it remains not entirely proved, because in a cornstarch test-meal the digestive action of the amylolytic ferment of saliva appears to be largely excluded.

The question of whether increased peristalsis has an adverse influence on absorption was brought up. We found that experimentally induced intestinal hyperperistalsis in animals reduced the hourly absorption of glucose from 1.7 gram to 1.4 gram per unit of body weight. We also found that starvation up to four days, hepatic injury due to phosphorus poisoning, fever, and dinitrophenol intoxication, all produced some diminution in absorption of glucose. However, the thyroid status of animals had the greatest influence on absorption. Thyroidectomy reduced the absorption of glucose in our animals to 0.9 gram, while administration of thyroxin increased it to 2.8 grams.

I agree with Doctor Koehler that, clinically, hyperperistalsis of the small intestine may cause intolerance to starches; but I also think that other factors which bring together unabsorbed carbohydrates and intestinal bacteria, such as excessive intake of starches or extension of the colonic flora into the small intestine, can produce the same effect.

Therapeutic administration of digestive enzymes is at present in such disrepute that the Council on Pharmacy and Chemistry of the American Medical Association does not accept any enzyme for oral administration. This state of affairs is due to the fact that digestive enzymes are almost universally given regardless of whether objective evidence of a deficiency exists, and that the amounts given are usually too small to be effective except as a form of psychotherapy. The clinical importance of the digestive enzymes will come into its own when we shall be able to prescribe them only in proved cases of deficiency and in amounts that are physiologically active. Doctor Koehler's work brings us a step nearer to this goal.

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HUGH FREIDEL, M.D. (1515 State Street, Santa Barbara).—Doctor Koehler should be congratulated for presenting these studies to us. More and more worth while studies of the small intestine functions are being reported daily, chiefly biochemical in nature. They all add something valuable to our knowledge of the abnormalities of the intestinal mechanism, and are of increasing aid to us in the caring for the same. Further contributions will be continued by just such studies as Doctor Koehler has made, and we all look forward to the gradual clearing of those hazy and uncertain ideas that are so prevalent concerning this most important digestive organ, the small intestine. It is to be hoped that further studies of the intestinal motility will offer to our knowledge new and worth while contributions, for I feel the disturbances in the motility, and the factors influencing them, are of the utmost importance.

I have felt the evaluation of quantitative estimations of the secretory functions of the small bowel to be of some benefit in diagnosis, but very little in therapy. And this

was due to the definite variable influences on the secretion by psychic and emotional stimuli so prevalent in the group of emotionally unstable individuals encountered. Doctor Koehler has apparently disposed of these factors to his satisfaction in his presentation of this study. All have seen cases of starch intolerance with frothy, fermentative stools, and with definite clinical evidence of marked indigestion, who, when away from their family and business worries, have metabolized starch in an adequate and satisfactory manner. Functional deficiencies, as determined by such laboratory findings, should be more constant.

I agree with Doctor Koehler that substitution therapy, using the various enzyme and digestive concentrates, is very disappointing. In order to get any benefit, even in the most evident case, much larger doses than usually used are necessary, and then only with preparations of a proved potency. Good results have been reported by using a properly prepared potent preparation of pancreatic juice in proved cases of pancreatic insufficiency. Ivy reports good results with large doses of pancreatin of proved potency in similar cases. Therefore, it seems to me that if the deficiency is real and not transitory, preparations of these concentrates, properly prepared and of known potency, would be of a greater benefit to these functional indigestions.

When we have further studies of the small intestine physiology, and especially its motility, made available most probably by new and improved roentgen studies, with a more skillful guiding and helping of these individuals to adjust themselves to their handicaps and to live within their capabilities, then and only then will our therapeutic results with these various functional indigestions and disturbances in motility of the small bowel be satisfactory.

THE ENDOCRINES AND BEHAVIOR IN PUBERTY*

By CLARA H. SPALDING, M.D.
Richmond

DISCUSSION *by Olga Bridgman, M. D., San Francisco; E. Kost Shelton, M. D., Los Angeles.*

THE child from eleven to sixteen is here discussed. The reasons for believing this group worthy of special consideration are threefold:

First: The universality of this critical time in every child's life.

Not every child will have broken bones or acute infection; but each child will, inevitably, have a period of puberty with its problems.

Second: Because of the importance of this period to the child himself, physically and emotionally.

Third: Because of the importance of the adjustment of the child toward society; the social economic value.

THE PHYSICAL CONSIDERATION

Pubescence interests us primarily because of its physiological changes, and the underlying anatomical changes, which means consideration of the endocrines.

The sum total of the child's previous life gradually brings to bud and blossom the gonadal system; the sex hormones of the pituitary gland, plus gonadal activity.

RÔLE OF THE PITUITARY

Regarding the pituitary as the keystone of the arch, we may pass lightly over the products of the posterior lobe, simply naming them for completeness:

1. That which affects the liver and so aids in fat metabolism.
2. That which aids the eye in mydriasis.
3. Three which affect the circulatory system:
   (*a*) Raises blood pressure.
   (*b*) Aids coagulability.
   (*c*) Controls capillary tone.
4. Two which bear upon the renal system:
   (*a*) Diuresis.
   (*b*) Antidiuresis.
5. Two which affect the uterus:
   (*a*) Alphahypophamin, the pressor.
   (*b*) Betahypophamin, the oxytocic principle.
6. Two which bear upon the digestive system:
   (*a*) One to the stomach, an inhibitor or gastric secretion.
   (*b*) One affecting the peristaltic action of the intestine.

One product of the pars intermedia:

1. Intermedia.

Then those of the anterior lobe, of whose eight products we mention seven briefly:

1. Parathyreotropic, parathormone.
2. Thyreotropic, thyrodin.
3. Suprarenalatropc, adrenalin or cortin.
4. One with galactagogue action.
5. Pancriaticotropic, insulin activator.
6. One affecting general growth.
7. One affecting skeletal growth, specifically.
8. The gonadotropic group, which we shall consider more closely.

GONADOTROPIC GROUP

Of the gonadotropic group, we have:

Prolan A, of which we have a male and a female entity:
1. That which affects the testicle, and whose specific function is the determination of spermatogenesis.
2. That which affects the follicle of the ovary—folliculin.

Prolan B, which, likewise, consists of a male and a female entity, as the case may be:
1. That which affects the testicle androtin.
2. That which affects the corpus luteum, progestin.

When the gonadotropic hormones mature and function normally, we have the group of secondary sex characteristics develop normally. If this physiological function be normal, we have the resultant normal emotional response on the part of the child, which predetermines that child's attitude toward life and society.

GROUPING OF CHILDREN

Children may, grossly, be divided into three groups:

First: The narrow top band of the precocious.

These children require great tact and understanding. Their ability to lead can be guided correctly, or they may easily develop their smart-aleck tendencies to be leaders of gangs.

Second: The bottom, much wider band of subnormals. The gradations range from:

1. The mildly retarded.

2. The feeble-minded—high-grade and low-grade morons. These are a definite menace to society because they are not adjusted, and are not capable of adjustment to the social economic system of today, with its complex problems.

The only hope for these two groups is early recognition, correct diagnosis, and adequate treatment of their endocrine dyscrasias.

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* Read before the Pediatrics Section of the California Medical Association at the sixty-sixth annual session, Del Monte, May 2–5, 1937.