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Enuresis

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ENURESIS

by

Dagmar Glood
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I. INTRODUCTION.

The multiplicity of ideas concerning theories of the etiology of enuresis, as well as its treatment, indicate that the problem is not entirely solved. It is probably due to the fact that no one cause is a factor. Davidson (24) states, "Much has been written, but relatively little is known of this condition which distresses mothers, shames children, and frequently baffles physicians" 867.

Nocturnal as well as diurnal enuresis is such a frequent finding and mothers, often ashamed of it, neglect seeking the advice of a physician when it is a condition which should be worked out thoroughly. It is often the source of social and economic damage to the individual suffering from the malady. Enuresis is not of interest because it endangers life, but because of the distress and mental conflicts that result, as well as the fact that it is the source of great annoyance and unhappiness and even tragedy to the family. As one writer states, this is a condition in which the diagnosis either precedes or comes in with the patient (80). Colburn (21) justly believes, "Such a syndrome is a heavy burden for a child to carry and affects his personality, undermining his self-respect, implanting a repression, and generally adversely affecting his moral and mental development" 67. Because of this a search for the cause should be made and treatment given.
The large number of suggested treatments illustrate the difficulty and many failures, but a wise approach should be made rather than negligently suggesting it will cease at puberty.

Enuresis has been defined by many authors depending upon their viewpoint as to its etiology. Davidson (24) states that enuresis is "the persistence from early infancy or the development during childhood of unintentional and usually unconscious nocturnal or diurnal emptying of the bladder in the absence of demonstrable organic nervous or genito-urinary lesions" 867. This definition conforms to the opinion of most of the recent writers but does not take into consideration the possibility of organic pathology, which must always be kept in mind. Fordyce (31) believes, "Incontinence demonstrates either neuro-muscular incoordination or faulty power of inhibition occurring during sleep, it must signify either excessive urgency of stimulation or torpidity of control" 38. Rewalt (75) adds, "Enuresis must be regarded as a benevolent stigma of an inherited nervous temperament" 147. These definitions illustrate other viewpoints of etiology.

Every author has some idea as to the causes and treatment, but there is no one definite idea presented. However, anything that disturbs a child, either physically or mentally, may be a factor in producing enuresis.
II. HISTORY.

Enuresis has always been a problem and one that has never been clearly understood. Duriz (20) in the 17th and 18th centuries wrote that it was "saturated with mysticism, the treatment was often of a bizarre nature; various contrivances were suggested as being useful to wear around the neck; the bed was made to face a certain direction; and baths containing various decoctions and aromatic herbs were used. The child was immersed in such baths for long periods every day" (413). Lallemand (19) in the late 19th century reports many cures with aromatic baths.

During (20) the Victorian era parents thought severe punishment was necessary in dealing with the problem, so cruel methods were used. Blows on the buttocks until there was redness was supposed to cure by counter-irritation. Boerhaave (19) and Caspar recommended burning the skin with hot irons. Later the passing of sounds and cautery added new ways of producing discomfort. Punishment was also given on the basis that enuresis was the result of laziness.

Wenock (19) thought that enuresis was caused by irritability of the detrusor muscle, stating no reason why, except that it was probably psychic. He injected water or drugs into the gluteal muscles, and when the patient did not return, he considered him cured. Forster (19) in 1860 pointed out that these practices were
"unjustifiable and cruel" 286, believing the shame felt by the child enough punishment.

Since that time an attempt to find a local cause was emphasized, and medicines were given on this basis. Phimosis, long foreskin or smegma retention was considered by many, including Adams (2), in 1887 as the main cause, so a large number of circumcisions were needlessly done. The statistics showed that enuresis was found as frequent in Jewish children as in Gentiles (19). Dittel (24), in 1872, thought enuresis the result of lack of development of the prostate and internal sphincter of the bladder. Adams (1), in 1885, considered the etiology to be atony of the sphincter. Together (19) with local treatment iron and arsenic were given as tonics to build up the general health, as most physicians thought that the child was weak, underdeveloped and anemic.

Sir Dominic Corrigan (20), in 1876, noted that the child usually slept on his back, so he advised elevating the foot of the bed to allow the urine to collect at the fundus of the bladder and not at the neck. Van Tienhoven (24), in 1890, also suggested raising the foot of the bed as a cure, and added collodion to seal over the meatus in both girls and boys. Means (19) of preventing the child from sleeping on his back were introduced to make this position uncomfortable. The child's buttock was blistered, a towel with a large knot on the back was wrapped around the child's waist
also a spool was tied to the back. Frequently they did not stay in place unless tied so tightly they interfered with respiration.

Another (19) theory set forth was that hyperacidity of the urine was the important factor, but with alkalinization enuresis still remained. Intestinal parasites were widely accepted as a cause, and vermifuges were given indiscriminately without going into the history or without any basis for their administration. Constipation was also considered a factor. Guyon (24), in 1897, considered the cause to be sphincter atony. Kapsamme, in 1903, believed that epidural injections of normal saline stimulated the spinal cord and increased bladder tonus.

Trousseau (73) first used belladonna in 1885 following Bretonneau's teachings. He considered enuresis a neurosis and noted that it was frequently associated with epilepsy and that there was often a family history of enuresis. Eustace Smith (19), West and Sachs had the first modern conception of the pathology present. Sachs, in 1896, urged training of the nervous system as a therapeutic aid and had good results. Then the anatomy and physiology was studied and it was found that micturition was primarily reflex and involuntary.

In general results were obtained in most of these treatments, not because it cleared up any local or general cause, but because of its psychic effect, or because enuresis spontaneously ceased.
III. PHYSIOLOGY OF MICTURITION.

A great deal of work has been done in studying the anatomy and physiology of the bladder in an attempt to solve the etiology of enuresis. This has been a step forward, and without which no progress could have been made. All writers, however, do not agree as to details of the mechanism, which is shown in their ideas concerning the anatomy and the action of the sphincter and bladder muscles.

Amberg (4) believes that the trigonal muscle is superimposed on actual bladder muscle and is continuous with the muscle of the ureters. This muscle opens the bladder orifice and is supplied by the sympathetics. He states that the sphincter is functional rather than anatomic. Another viewpoint set forth by Sundell (69) is that the vesicle fibers form a ring around the urethral orifice, and, he adds, the urethral sphincter is powerful and is a specialized muscle bundle which loops around the beginning of the urethra as a sling. The voluntary sphincter (bulb-cavernous muscle) can be controlled even when the bladder is distended.

Wylder's (80) findings indicate that the trigone muscle is supplied by the sympathetics only and functions by opening and closing the bladder outlet, as there is no internal sphincter in man, and the so-called sphincter is made from circular and partly from the longitudinal coats of the bladder wall. Kräfft (48) states there are
two muscles, the sphincter and detrusor, and both are supplied by the third and fourth and probably fifth sacral nerves. The motor centers keep the sphincter contracted and the detrusor relaxed. Most authorities, however, agree (5) that the pelvic nerve (second - fourth sacral) is the motor nerve to the detrusor and with its contraction the urethra relaxes. The hypogastric nerve (eleventh thoracic - second lumbar) is thought inhibitory. Elliott, 1907, showed the antagonistic action of the two nerves in the cat. However, it may be merely the tonic contraction of the urethra that holds the urine in the bladder.

Wile and Orgel (76) describe the nerve supply as furnished by the upper four lumbar nerves through the sympathetic system and second and third sacral nerves through the pelvic visceral nerves. They quote Starling who gives us a detailed picture of the nerve supply. He says the upper lumbar nerves send branches to the lateral chain of sympathetics and on to the inferior mesenteric ganglia. Other axons go through the hypogastric nerve to the plexus at the base of the bladder and on to the bladder. The pelvic nerve passes directly to the hypogastric plexus, then to the neck of the bladder. Stimulation of the sensory nerves causes reflex contraction. Micturition is primarily a reflex act which is controlled by a center in the lumbo-sacral part of the cord.

A very good description of the anatomy and physiology of
the bladder is given in Collie's (22) article. His ideas, in the main, are accepted by most authorities. He states that while urine accumulates the sphincters contract so it cannot escape. Antagonizing the sphincter in its action are the muscles in the bladder wall, and the nerve supply of the two are so related that, with relaxation of the sphincter, the bladder contracts and vice versa. When bladder pressure has increased to a certain point, the nerve endings in the bladder wall send impulses to the micturition center in the lumbar part of the cord at the level of the twelfth thoracic and first lumbar vertebrae. These send impulses for contraction back to the bladder via the pelvic nerve, causing the detrusor to contract while the sphincter relaxes and the bladder empties. This forms the reflex arc.

Voluntary control also enters in. Impulses from the centers in the cord go to some center in the midbrain, which is the inhibitory center, and then down the cord again to the bladder, through the sympathetic system, which has an action antagonistic to the reflex arc. This is not present at birth and is acquired through training, education, repetition and habit during the first few years of life, and once voluntary control is established it plays the greatest role. The (5) exact method of cerebral control of the emptying function of the bladder is questionable, but the spinal center is under central control. Various authors locate this center in
different parts of the cerebrum. In the researches of Forster, Ader and Van Kleist, it is located in the region of the paracentral lobule. Rietschel placed it somewhere in the frontal area with probable subcenters in the region of the striate body. Moss (56) quotes Grunbaum and Sherrington who say it is located at the apex of the motor convolution in the foot region. Marberry and Czylharz place it in the hip area.

The (56) sphincters are always tonically contracted and the bladder empties itself by sphincter relaxation and contraction of the detrusors. Chetwood (92) believes that in children the detrusor is stronger than in adults so when the will is lost, as during sleep, there is an involuntary emptying.

The source and presence of the sensation of desire to void is disputed. Moss (56) says the feeling of desire to urinate is due to the pressure of fluid. The increased pressure stimulates the higher center, which may voluntarily remove the inhibition on the lower center, and urine is expelled by reflex contraction of the bladder wall. Collie (22) emphasized the associated feelings of cleanliness, decency and circumstances that enter in. If conditions are favorable micturition takes place, but it can be prevented in unfavorable circumstances. The pudic branch of the sacral plexus acts on the compressor urethrae and prohibits urine outflow. However, the bladder is very sensitive to reflex stimuli, so local irritation
or sensory psychic stimuli may cause a contraction (54). Amberg (3) quotes Weitz and Götz who, in their experimentation, filled the bladder with boric acid solution through a catheter under different pressures and then attached a manometer. In enuretics he noted there was a lack of desire even though bladder contractions were present, but other writers have found desire present in enuretics as well as normal children. Guyon and Müller-Würzburg found the bladder mucosa produced only a sensation of distension that later gives rise to desire. Guyon thinks contraction of the bladder wall immediately precedes desire, while Schwarz maintains the tension of the bladder wall is the source of desire. Steiner (68) holds that desire always precedes urination and induces contraction of the bladder, but Emerson (29) believes the child is either unconscious of a desire or disregards it.
III. INCIDENCE, ONSET AND TYPE.

Statistics as presented by different authors vary greatly, but they give us some idea of the findings.

1. Incidence.

Pese (5), 1920, found that enuresis was a problem in thirty percent of all the small children and ten percent of the older children at a children's asylum in Breslau. Dunham (28), 1916, says that of the 800 nervous children admitted to Phipps between five and sixteen years, seven percent were bed wetters. Cimbal (5), 1927, finds that it occurs in twelve to fifteen percent of all nervous children. Adams (1), 1885, states that of 19,261 cases only 55 came in for treatment. Townsend (72), 1887, finds that in 1500 cases at the Boston Child's Hospital 25 had enuresis. Seven and seven tenths percent of 12,700 children was found to be enuretic by Drum (58) in 1921. Horton (42) in 1929 gives five percent of total number as being enuretic.

2. Sex. (Quoting Anderson (5) )

Schwarz, 1923, says that of 226 cases, 148 were boys; Grover, 1918, finds sixty-two percent boys in 200 cases; Burnet believes it more frequent in males; Firth, 1911, treated more girls than boys; and Walker, 1923, states it equally distributed among the sexes. In general most writers believe it is found in equal numbers or slightly increased in boys, so enuresis is not on an anatomical basis.
3. Onset.

Anderson (5) quotes the percentages given by Schroeder in 1927. Thirty-seven percent begin in infancy, nine percent in the pre-school age, two percent in the preadolescent age and fifty percent at an undetermined age. In Anderson's (6) review of the literature he finds that over eighty percent begin in infancy and continue beyond that period. Davidson (24) gives eighty-six and five tenths percent as dating from infancy and thirteen and five tenths percent as beginning later. Hubert (43) finds fifty-eight percent dating from infancy, Grover (38) seventy-nine percent, Muldower (57) eighty-six percent and both Amberg (3) and Calvin (15) think onset is in infancy. However, Walker (75) says sixty percent develop between five and eight years. Wylder (80) believes most have a period of normal control before enuresis begins. Most of the authors, however, agree that the largest percentage persist from infancy though some occur after a normal period of control. Why enuresis should develop after a period of voluntary control is questionable. Writers such as Grover (38) and Calvin (15) think it recurs after an illness like measles, scarlet fever or chorea or after some unusual excitement or fright. Anderson (6) states that two thirds of the later cases had some precipitating cause for their appearance. A certain number will cease spontaneously at puberty. Amberg (4) and Helmholtz (21) believe it rarely goes beyond and
associates it with the development of the sex apparatus. The normal (78) age for control is usually established at twelve months, when
the child should be familiar with the stool and voluntary micturition
with some reliability; and at eighteen months it should be but a
rare accident during the day; and by two years, a rare accident at
night. So by two and one-half to three years complete voluntary con-
trol should be established.

4. Type.

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Anderson (6)</th>
<th>Davidson (7)</th>
<th>Zappert</th>
<th>Holt</th>
<th>Still</th>
<th>Ostheimer (59)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(8) cases</td>
<td>35.5</td>
<td>44</td>
<td>39.6</td>
<td>52</td>
<td>58.8</td>
</tr>
<tr>
<td>nocturnal only</td>
<td>4/5 all cases</td>
<td>35.5</td>
<td>44</td>
<td>39.6</td>
<td>52</td>
<td>58.8</td>
</tr>
<tr>
<td>diurnal only</td>
<td>3%</td>
<td>1.5</td>
<td>0</td>
<td>4.9</td>
<td>5</td>
<td>2.2</td>
</tr>
<tr>
<td>diurnal &amp; nocturnal</td>
<td>11%</td>
<td>64.0</td>
<td>56</td>
<td>55.5</td>
<td>44</td>
<td>39.0</td>
</tr>
<tr>
<td>assoc. with fecal incontinence</td>
<td>7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The greatest number are purely nocturnal or associated with diurnal enuresis. It is sometimes associated with fecal in-
continence, especially in the mental deficients. Anderson (6) says
this includes seven percent of the number and Cameron (16) gives six
percent.

5. Frequency.

Many enuretics have frequency and urgency (pollakiuria).

This was noted by Guyon (4) who believed it due to atony of the sphincter
It is a symptom of such local pathology as cystitis, or hyperexcitability
of the bladder from disturbance in the reflex mechanism (Walker, 75).
Wetting may occur several times a night, or every night. Anderson (6) gives the average number of wet periods as five a week. Wetting occurs at a fairly definite time each night. Bakwin (8) says it is worse during the winter, but Davidson (24) does not confirm this.

6. Other findings (Anderson 6).
   a. Race and color:

   Racial group division shows no evidence to consider it a factor. Color is not important.

   b. Natal condition:

   There is no relationship between illegitimacy or the feeling of inferiority resulting from illegitimacy and enuresis. Only five cases were born before the eighth month of development, therefore the effect of a less developed nervous system is still a question. Only thirteen percent of the births in enuresis were not spontaneous, while in the normal group twenty-four percent were instrumental, so type of birth is not a factor.

   c. Postnatal conditions:

   Duration of breast feeding is about six months for normal children and eight months for enuretic children. Gilkey and Draney of Kansas City believe there is a relationship between the duration of breast feeding and infantile traits. The average period of dentition, walking and talking is slightly increased in the
enuretic, but it is not conclusive. There is no difference in the height-weight rates of the two groups.

d. Economic stress:

In general the economic level is not a factor and occurs in children of different financial levels. In the more wealthy families it is emphasized by worry and overattention; in the poorer families, by punishment.
V. CLASSIFICATION.

The classifications are listed in chronological order. It is noted that in the beginning the classification was on a physical basis; later the neurotic or nonphysical basis was emphasized; and of recent years most classifications include both groups, which is most logical in a complete study of the subject.

(1) Townsend (1887).

1. Reflex:
   a. Increased amount of urine: (1) Diabetes (2) Nephritis.
   b. Irritant quality of urine: (1) Acid (2) Alkaline.
   c. Vesical calculus.
   d. Hypersensitive state of external genitalia from:
      (1) Stricture of urethra (2) Phimosis (3) Balanitis.
   e. Anal irritation from:
      (1) Pin Worms (2) Eczema (3) Fissure.
   f. Increased bladder irritability.

2. Atony of the sphincter vesicae:
   a. General debility
   b. Spinal lesions
   c. Acute febrile disease.

3. Malformations of the bladder and urethra.
(2) Ostheimer and Levi (1904):
   1. Reflex
   2. Atony of sphincter vesicae
   3. Malformation of bladder or urethra.

(3) Sundell (1921):
   1. Unconscious micturition:
      a. Those with mental defects, petit mal
      b. Those with physical abnormality of bladder and urethra
   2. Urgent micturition (cause is nervous).

(4) Walker (1923):
   1. Apathic make up, with atony of the bladder
   2. High strung, intelligent, with deep sleep
   3. Deep sleepers.

(5) Thursfield (1923):
   1. Congenital--those having enuresis constantly since birth
   2. Acquired.

(6) Saxl and Kurzweil (1923):
   1. Due to local irritation
      a. Oxyuris Vermicularis (pin worms)
      b. Masturbation
      c. Vulvovaginitis
      d. Cystitis
      e. Fissure in ano
f. Rectal polypi

g. Phimosis

h. Balanitis

i. Tonsils and adenoids

j. Renal calculus

k. Vesical calculus

l. Malformation of the genital tract

m. Adherent clitoris.

2. Due to general ailments:

a. Neurasthenias and neuroses

b. Anemia

c. Neurogenic diseases

d. Malnutrition

3. Due to endocrines:

a. Actual disturbance, i.e., cretinism

b. Indefinite or slight disturbance

4. Due to urine:

a. Highly acid, concentrated urine

b. Diabetes insipidus

c. Diabetes mellitus

d. Nephritis

5. Idiopathic—undetermined origin.

(7) Wile (1924):

1. Peripheral

a. Malformations: Epispadias, ectropia vesicae, hypospadias,
patent urachus, vesico-rectal fistula, phimosis, small meatus.

b. Trauma, inflammation, new growths: Balanitis--adherent clitoris, cystitis--preputial adhesions, calculus, stenosis--incontinence of retention, tumor of bladder.

c. Metabolic: Acid urine, constipation, endocrine disturbance, diabetes mellitus.

d. Reflex: Pin worms, vulvovaginitis, anal fissure and rectal polypus, masturbation, pertussis.

2. Spinal:
   a. Malformation: Spina bifida occulta
   b. Inflammation, trauma: Potts' Disease--myelitis (lumbar cord)
   c. Reflex: hyperirritability of spinal center (?).

3. Cerebral:
   a. Organic:
      (1) Malformation and retarded development: Mongolism, infantilism, idiosy, cretinism.
      (2) Diseased states, trauma, new growths: Tumors, chronic meningitis, diabetes insipidus, epilepsy, chorea, hydrocephalus.
   
   b. Functional:
      (1) Metabolic: General debility, malnutrition, rickets, intoxication, pathologic sleep.
      (2) Psychic: Neurasthenia, dreams, hysteria, neurosis, psychosis--weak attention, weak will, worry and anxiety, fear and malice.

   (8) Moss (1925):
      1. Pathological with increased urine output
a. Diabetes mellitus, cerebral conditions, lithiosis.

2. Reflex—responding to psychical and sensory stimuli
   a. Phimosis, pin worm, masturbation, neurotic and psychic conditions.

3. Idiopathic or functional (no special cause)

4. Endocrine disturbance.

(9) Calvin (1928):

1. Organic or physical disturbance
   b. Internal glandular disturbances: Diabetes insipida.
   c. Urinary changes: Hyperacidity, reversal of specific gravity of day and night urine.
   e. Local irritations of neighboring organs: Phimosis, pin worms, etc.

2. Bad habit formation due to lack of good training or the result of an oversensitive nervous system.

(10) Bakwin (1928):

1. Those due to "irritable bladder" and frequency and urgency as prominent symptoms.

2. Those dependent on psychological maladjustment.

3. Those due to inadequate training, in careless, slovenly and hyposensitive children.
(11) Pototzky (1930):

1. Neuropathic children
   a. Hypersensitive
   b. Conditioned reflex.

2. Psychopathic
   a. Defiant, unstable
   b. Shy, timid
   c. Indifferent, phlegmatic.

3. Fetalistic
   a. Lack of harmonious development.

4. Pathocranial
   a. Hypothyroidism
   b. Hyperthyroidism.

5. Disturbed intellect
   a. Epilepsy
   b. Post encephalitis
   c. Imbeciles.

Wile's classification is the most complete as far as including the greatest number of possible causes is concerned, but it omits an important factor, faulty training, which is mentioned by Calvin. These classifications give us an idea of the advance made, from purely local causes to nervous factors, then including general causes as well as endocrine disturbances. Later faulty training and the psychic element are added. Of recent years these have been ascribed as the chief factors.
VI. THEORIES OF ETIOLOGY.

I. Physical causes:

The earlier writers attributed enuresis to a general physical inferiority, but, though physical factors must be considered, they do no play as large a role as formerly thought. The fact that Woolley (78) gives as high as ninety percent, while Anderson (6) says seventy percent have no physical causes, would indicate other factors as more important. It is generally accepted that enuretic children are healthy and active (Zappert, 63) but Pototzky emphasizes that some defect can usually be found.

A. Local causes:

1. Bladder disturbances

   a. Cystitis may account for a few cases of bed-wetting. This number is given as twenty percent of the total number of Fleischer's 1911 cases, however, most authorities believe this figure is too high. Undoubtedly a thorough urological examination is always indicated, especially if the enuresis is persistent and does not respond to general treatment (21); for many conditions, such as pyelitis, calculi, malformations of the bladder or tuberculosis, may be overlooked.

   b. Atonic sphincter and nerve supply. Fordyce (31) quotes Smellie, who describes "essential enuresis" as an atonic condition of the internal sphincter due, either to hypofunction of the
motor nerves to the bladder, or lack of tone of the unstriped muscle fibers themselves. Among others, Wile and Orgel (76), Gibbs (35) and Blau (9) maintain that sphincter atony is the factor, and Blau considers it the result of a neurosis from an underdeveloped or unstable nervous system.

Every author has his own idea as to the local factor involved. Grover (38) maintains the bladder capacity is small, and the bladder constantly empties itself. To quote Trousseau (73) "it is a neurosis manifesting itself by excessive irritability of the bladder" 481. Others hold it is the result of local irritation produced by cystitis, concentrated or hyperacid urine causing the bladder to contract in reflex response to the slightest stimulus because of the hyper-excitabile condition. In children the detrusor muscle is thicker and stronger than in adults. As a result Czylharz and Marbury (56), Chetwood (54) and Fulton (34) contend that during sleep, when cerebral control is lost the urine is involuntarily extruded. Pelzman (60) reports that in sixty cases of enuresis a trebeculated bladder, usually involving the floor, was a frequent finding.

Wile and Orgel (76) give Holt's classification of causes:

1. Continued infantile condition, anything that increases the irritability of the spinal center.

2. Anything interferring with cerebral control over the center.

3. Anything increasing the irritability of the terminal filaments of the bladder nerves.
This classification includes most of the accepted ideas relating to the bladder itself or its nerve supply.

Many authorities including Sundell (69) state there is a dulling of cerebral perception. This may be the result of deficient mentality, family training or deep sleep. The last is thought to produce too rapid filling of the bladder or a reflex emptying due to the stimulus of some local or neighboring impulse. Wile and Orgel (76) state that peripheral causes are most frequent, while Gibbs (35), Pisek (61) and Holt (43) agree that the main trouble is in the higher or cerebral centers. Thus, involuntary urination results from lack of control over the reflex emptying of the bladder. With the aid of the capillaroscope, Pototzky (67) found a large number of pronounced vaso-neuroses based on hypersensitiveness of the patient. The child responds to the slightest sensory stimulus, such as exposure to cold, resulting in a disturbance of the vasomotor mechanism of the bladder. Psychic as well as physical stimuli may upset the balance.

Hypervagotonia or vagotonia has Muldower (57) as its chief exponent. Vagotonia is used in the sense of the entire autonomic nervous system and may be latent or active. It is "a symptom complex manifested clinically by an increased irritation or stimulation of the sympathetic or parasympathetic system" 433. Many times sympathetic stimulation is seen to cause incontinence, and to come from psychic, peripheral or endocrine sources. Sicard (67) limits the
hypervagotonia to the pelvic plexus and says it produces bladder spasm.

2. Urine

Hyperacidity, hyperalkalinity and concentrated urine are often considered factors though not the main cause. The hyperacidity may have an irritating effect on the bladder mucosa and nerve endings resulting in frequent involuntary micturition. An excessive number of bacteria and amount of pus may be associated with hyperacidity. Fordyce (31) and Smellie find the urine usually negative. Other writers, including Cameron (16), Chandler (20) and Friedell (32), note that instead of a concentrated urine there is, in some cases, a low specific gravity of day and night specimens. Friedell finds the concentration less in the night urine than in the day. This is contrary to the findings of Mohr (55).

3. Phimosis and adherent prepuce or clitoris

Local irritation from an adherent prepuce or phimosis, with the collection of smegma, was given by the early writers (Trousseau, 73) as one of the main causes of enuresis, so many circumcisions were done without effect. Wile (76), among others, believes this condition, as well as other local findings, produces reflex voiding from irritation. but the part it plays is questionable.
4. Pin worms

Grover (38) finds that in 200 cases, twenty percent had pin worms, so he considers it an important factor. Other neighboring conditions; such as anal fissure, polypi and vaginitis; produce enuresis by a similar effect, local irritation.

B. General causes:

1. Tonsils and adenoids

Hypertrophied tonsils and adenoids are given as a factor in a few cases, especially if they obstruct breathing. Sundell (69) and Karger (46) have the opinion they produce a partial asphyxia of the higher centers with a dulling of cerebral perception, urination becoming a reflex act. In a large number of children the tonsils and adenoids are enlarged, but their effect on enuresis is questionable because in many instances their removal brings no relief. Grover (39) says that in two hundred cases thirty-six percent had their adenoids removed without relief and that tonsils, if their presence has any effect at all, only increase the general body fatigue. Bleyer (10), Blau (9) and Abt, who is quoted by Wyler (79), doubt if they have any effect and say that the supposed cures reported by some authors after their removal are probably psychic.

2. Rheumatic fever

Davidson (24) says rheumatic fever has no effect on enuresis, but Still gives five and five tenths percent of 200 cases and
Horton (42) thirteen percent of sixty cases as having rheumatism.

3. Eye strain

Redway, quoted by Gibbs (35), writes that some, if not all, cases of enuresis can be traced to errors of refraction because of the proximity of the optic and micturition centers. Bleyer (10), however, found in his study that correction of the defect has no effect on enuresis.

4. Tuberculosis

Enuresis as a manifestation of light pulmonary tuberculosis is mentioned by Keersmacker (56) and Pototzky (63), but the latter states the relationship of the two cannot be confirmed, though the fever may be the factor involved. Amberg (3) recommends the use of tuberculin in enuretic children.

5. Diet

Various opinions are expressed concerning the importance of diet. It is known that a diet rich in salts and carbohydrates, with increased fluid intake, increases urine output. Grover (38) concludes that an unbalanced diet and eating between meals aids in producing neuro-muscular fatigue. Malnutrition was early considered to be a cause and this view is still held by Fulton (34), Holt (71) and Calvin (15), but Zappert (24) is of the opposite opinion. Enuretic children compare favorably with nonenuretics as to height and weight according to most statistics.
6. Endocrine disturbance

Saxl and Kurzweil (65) state that writers such as Williams of London, Hertoghe of Antwerp and Leopold Levi of Paris demonstrated thyroid disturbances to be a common cause of enuresis. Hertoghe based his conclusion on the fact that hypothyroidism causes cellular infiltration of the bladder as well as other tissues with a desquamation of the bladder wall. As a result, with irritation the wall is easily stimulated to contract. Saxl notes that in hypothyroidism and pituitarism there is poor bladder control during sleep. This is due to a dulling of cerebral perception on an endocrine basis according to Sundell (69). Pototzky (62) finds hyperthyroidism and enuresis frequently associated. The application of ephedrin to the bladder wall, as noted by Dunham (28), causes relaxation, so he maintains enuresis is due to glandular disharmony.

7. Spasmophilic form

Macciotta (51) finds that in seventeen percent of twenty-four cases there are spasmophilic characteristics with "an increased galvanic excitability, a decrease in the calcium index, a moderate decrease in the ionic concentration, and varied signs of mechanical hyperexcitability" 968. This spasmophilic characteristic together with constitutional and local factors, in his opinion, produces nocturnal enuresis and he has had excellent results with the administration of Vitamin B, together with ultra-violet rays, and in some cases parathyroid extract.
8. Allergic phenomena

Bray (13) finds that in 1000 cases of allergic children five percent of those over seven years had some degree of enuresis. He bases the association of the two on the nerve supply. The smooth muscles of the walls of the bronchi are constrictor fibers from the cranial division of the parasympathetics, and the motor fibers to the detrusor muscle of the bladder and the inhibitory fibers to the internal sphincter come from the sacral division of the same system. Thus the stimulation of the parasympathetic system may produce either broncho-spasm or the release of urine or both. He adds that action is counteracted by stimulation of the sympathetics so the latter may be used to cure enuresis. Clinically this has been demonstrated by the use of ephedrin in patients with spastic vesicle sphincters. He continues the analogy between allergic cases and enuresis by stating that they both occur in bouts with free intervals, both are worse at night, and both increase fatigue and worry. The allergists believe that enuresis may be the result of sensitization to certain proteins.

9. Neuro-muscular fatigue

Neuro-muscular fatigue has as its chief exponents Grover (38) and Fulton (34). Children who are very active during the day, especially if they are nervous, are overtired at night, both from a physical and mental stress. As a result they sleep more soundly than usual, but are never rested. The chronic exhaustion that follows leads
to loss of muscle tone and control. These children are hard to rouse at night and fail to respond to the urge for voiding. Any physical factor, such as faulty diet or local irritation, is thought to enhance the fatigue.

10. Surgical conditions

Gross surgical conditions; such as stone in the bladder or urethra, tuberculosis of the urinary tract, or definite nervous lesions with paralysis of the bladder, or vesico-vaginal fistulae; must be considered, although their occurrence is not frequent.

11. Influence of posture

Anderson (6) quotes Lipman, 1921, who found that, after placing a child in the extreme kyphotic position an hour before bedtime and then emptying the bladder, he remained dry all night. This posture is believed to increase renal activity. Sleeping on the back is thought to induce bed-wetting, so various devices have been used to make this position uncomfortable.

C. Spina bifida occulta and other congenital anomalies:

Von Recklinghouse, 1886, was one of the first to maintain that spina bifida was a factor. Leopold (49) defines spina bifida as a bifid spine with or without protrusion of spinal structures. It is usually not until later in the development of the child that the membranous band bridging the gap begins to compress the nerve roots.
When it does occur, enuresis frequently results. Arnesen (7) found that six percent of his cases had spina-bifida. Fuchs quoted by Colburn (21) gives thirty five percent of his cases. Some men claim their patients are cured following operation to remove the membranous band, but others have no results. X-ray studies show that spina bifida is found in as many children with enuresis as without.

Other congenital anomalies may be found associated with enuresis, as malformation of toes, vesico-vaginal fistula, malformations of the lower urinary tract--epispadias, hypospadias and a cleft bladder.

It is generally accepted that physical causes may be a factor in a few cases and should always be considered, sought for and corrected, even though they may not play a direct part in the etiology. Correction would aid in building up or maintaining the general health of the child. Other causes have been mentioned in the literature, but they are not of special importance.

II. Functional theories:

A. The unstable, nervous child:

A very apt statement, and one that expresses the opinion of most authorities, is written by Blau (9), "I am tempted to say that the average case displays no tangible anomaly or infirmity definitely causative in nature" 600. The many psychogenic theories that have come
to the foreground in recent years illustrate the trend of thought as
to the etiology of enuresis.

The first to emphasize the neurotic element in enuretics
was Guinou in 1889. Davidson (24) finds a neuropathic constitution in
eighteen and five tenths percent of his cases, so he concludes it is an
important factor. Twenty-five percent of the children studied by
Bleyer (10) had an unstable nervous system, but many were superior as
to heredity and environment. The nervous instability (Mohr and Water-
house, 55) is shown by a tendency to emotional conflicts. Horton finds
this group comprising sixty-six percent of his cases. Janet, quoted by
Amberg (3), emphatically asserts that all cases not resulting from
epilepsy or atony of the sphincter are purely psychogenic in origin.
All but twenty-eight percent of Trümmer's cases had a neuropathic factor.
He concludes that the success of suggestive therapy is an indication of
the psychic etiology. This conclusion is not accepted by Pfister, for he
asserts that organic disease may also be influenced and improved by
suggestion.

A normal child has a greater response to sensory stimuli,
such as fright or excitement, than adults, for his inhibitions are not
developed; while a neurotic child is still more susceptible than a
normal one. The writers, assuming a neurotic basis, state that the
neurosis interferes with the physiology of micturition by increasing or
decreasing the excitability of the bladder, and also by a dulling of
cerebral perception, so desire for urination is lost. Sundell (69) adds that urgency becomes a factor in the nervous child. He has many failures in properly voiding and, because of the urgency, becomes anxious about his condition. A greater nervous exhaustion is produced and, in turn, a lessened ability to control. Chandler (20) believes the lack of cerebral control produces the urgency.

Enuresis is one of a number of nervous symptoms and may be from nervous hyperexcitability, psychopathy or defects of intelligence, according to Pototsky (62). In his classification of the psychopathic type he notes that wetting the bed occurs from fright following repeated punishment in a hypersensitive child, or from lack of concentration and absentmindedness that is continued in sleep. It may be, if there is a lack of moral feeling or sense of cleanliness, that the education of the child is at fault. The environment, as well as the mental attitude of the child toward the problem, has a marked effect. In some instances a suggestion of the presence of weak kidneys may begin a period of incontinence, the child thinking he lacks control and making no effort to overcome it. Because of a psychogenic basis, Crothers thinks the child can stop by his own will power.

Cameron (16) is one of the main exponents of the hysterical origin. As the child is very suggestible, his failures to overcome the habit becomes a source of worry and shame. The hysterical
manifestation is often the result of maternal anxieties concentrated on the genito-urinary tract through apprehensions of the mother conveyed to the child by suggestion. Theimish and those of the Breslau School (Gibbs, 35) also believe it is a manifestation of hysteria. Feer (79) includes hysteria and says it is evidence of "hereditary stigma of degenerative inferiority" 58. Cameron (17) bases his belief in the etiology upon the following definition given by Babinski, "Hysteria is a pathological state manifesting itself by trouble which it is possible to reproduce by suggestion in certain individuals with perfect exactitude, and which can be made to disappear under the influence of persuasion (counter-suggestion) alone"; also, "Hysteria is the condition in which symptoms are present which have resulted from suggestion and are curable by psychotherapy--A.F. Hurst" 485. He recognized the fact that proving the presence of a hysterical anaesthetic bladder is difficult, but does not see why it isn't possible, even though hysteria itself is rare in children. The origin of the manifestation is unfortunate suggestions, made through fears of the mother. The child is usually intelligent and very sensitive to criticism, wishes to stop the habit; worries about his failure until he loses self-confidence, and then assumes an attitude of aloofness, that is not laziness and which punishment only aggravates.

Dreams of urination are stressed by Janet in 1890 (63). During sleep the desire to urinate is impressed on the mind and after
a number of stimuli the child believes he has gotten up to void and is conscious of passing water. Moss (56), Muldower (57) and Walker (75) also believe dreams have an influence. However, it is questioned whether the dream is the cause or the result. Schwarz, quoted by Anderson (5), thinks it is the result. Zappert states that dreams do not develop until years after enuresis is established, and a large number of enuretics do not dream.

Conditioned reflexes, as hearing running water, sometimes produce the desire to urinate. The child may also automatically void, as in shock, fright or extreme emotion. It is found that after an exciting day enuresis follows. However, these are not specific causes.

Psychanalytic views are stressed by Stekel, Klasi, Abraham and Hubert. Schwarz thinks enuresis is a flight from unbearable circumstances (5).

B. Faulty training:

Faulty training undoubtedly plays a part. Woolley (78) lists the factors in the following manner:

1. Postponing the natural period of training so the habit of reflex micturition becomes firmly fixed without regard to circumstances. The bad habit must then be broken, as well as a good one established. This is more difficult after the child is old enough to assume a greater
independence of personality, as he will resist efforts of training.

2. The establishment of a negative reaction: After a child has had some experience of independent action, he likes to try out his ability in opposing his mother by wetting himself. Changing the attitude of the child is necessary for success, but frequently a negative child is treated with dominance and inconsistent methods.

3. The love of emotional scenes: A child likes excitement and, if he finds himself the object of worry and concern, resulting emotional scenes such as tears or excessive loving, he will wet the bed so as to remain the center of interest.

4. Fear: With failure of training, often associated with punishment, the child may begin to fear he cannot control himself, even though he may so desire. Shame and social disapproval are a source of mental punishment. The child wants to be well thought of, but the fear of failure prevents proper control. A feeling of inferiority will develop in time. It is important in such a case to overlook failures and establish self-confidence.

5. Infantile dependence on the mother: In some cases the child wishes to continue the infantile state of complete dependence on the mother so as to receive excessive attention, as he fears he will lose it otherwise. The child does not want to assume responsibility or his own care.

Woolley assumes, in these cases, that there is no physical
cause and the problem is mainly one of training and changing the attitude of the child. Krafft (48) adds that, in a poor environment with unstable parents, training is bad; and punishment which is frequent only aggravates the condition. Chandler (20) and Wylder (81), as well as others, mention faulty training, and the former believes that with proper training and cooperation of the parents twenty percent of the cases can be rapidly cured and the others can be in time. Sutherland, quoted by Wile and Orgel (76), aptly states, "In many intractable cases we are dealing with a bad habit, pure and simple; with a defective power of cerebral control, owing to a defective power of parental control; and the stimulus of strangers and an ordered establishment was sufficient to bring out the dormant inhibitory powers". The statistics compiled by Anderson (6) list faulty training at the head (eighty-seven percent).

C. Other factors:

1. Masturbation

This has been considered a factor for years. Trousseau (73) mentions it in his writings. Hernaman and Johnson think enuresis is a kind of vicarious sexual act and Walker (75) believes it brings a degree of sex gratification. Many authorities, including Muldower (57), state that it is a masturbatory equivalent. It is thought the child derives an erotic sensation from frequent emptying of the bladder and gratification is experienced without
a feeling of guilt. Its influence is probably overstressed, for masturbation exists without enuresis, and enuresis without masturbation. Cameron (17), in opposing Freudian psychology's claim that enuresis is a variant of masturbation, states that the misery experienced by the enuretic child and his willingness to be cured would not support Freud's view. Also masturbation is a stereotyped action, such as thumb sucking, to create a particular sensation which results in a feeling of gratification. To attempt to cure this habit makes the child irritable instead of cooperative, as is the case in enuresis. However, the two may be associated, but each is distinct. Masturbation is voluntary while enuresis is involuntary.

2. Depth of sleep

In infancy only the lower centers function, so Carter (19) and Wile (76) think it possible that during sleep the conducting paths only partly function, as inhibition is lowest at that time. Enuretics are considered to be excessively deep sleepers by writers such as Fulton (34), Chandler (20), Mitchell (54), Harill (40) and Pototsky (63). Fulton adds that deep sleep is the result of neuro-muscular fatigue, so the cerebral centers do not respond and urination becomes reflex. A greater impulse is necessary to rouse the child and the desire for urination may not be strong enough to get through consciousness. Courtin (23) and Amberg (3), in their studies, found no connection between the depth of sleep and enuresis. As
many non-enuretics were deep sleepers as were enuretics.

3. Intelligence

Authors vary in their findings. It is true that mentally retarded and defective children, as mentioned by Grover (38), Sundell (69), Fordyce (34) and others, are frequently enuretics, but these do not represent the greatest number of cases. Here enuresis is largely the result of their mental status with lack of normal cerebral processes and formation of good social habits. However, many authors believe that the average enuretic rates well in intelligence tests and is a bright, active child. From Anderson's (6) studies the enuretic child is seen to be slightly above the average in intelligence tests. About a fourth of the children were superior. Schroeder, quoted by Anderson, reports an I Q below 70 in 7% of cases; an I Q below 70-80 in 25%; below 80-90 in 30%; below 90-110 in 36%; and below 110-120 in 2% of cases. Partridge found in the Vineland School for the feeble minded 10% were enuretics. In the data listed by Mohr and Waterhouse (55) there is found the statement that the non-enuretic does slightly better work than the enuretic. In all these the numbers studied were not large enough to give any accurate information.

4. Heredity

The part heredity plays is not known, but many cases give a family history of some relative or parent with troublesome enuresis as a child. Amberg (3) adds there is a familial type of enuresis
and Hubert (43) believes it the result of some inherited defect, but the part it plays must be considered together with the effect of environment, as well as the general condition of the child. The inheritance of an unstable nervous system, together with faulty management is given as Cameron's (16) viewpoint. Trousseau (73) states, "on examining into the hereditary antecedents of the patient, you will find more than enough to explain the existence of the malady" 479. A family history was found in fifty-six percent of 200 cases by Grover (38); Horton (42) gives fifty-six six tenths percent; Hubert (43), forty percent.

5. Epilepsy

It has been suggested that children having a family history of epilepsy were prone to develop enuresis, but Hubert (43) finds only eight percent with such a history. The relationship and association of the two has been mentioned by Trousseau (73), Holt, Wile and Oriel (76), Moss (56) and others, but Zappert (5) regards them as distinct findings. Pototzky (63) sets forth the idea that enuresis is frequently the first symptom noted in epilepsy where the epileptic attack itself is overlooked. If the history is suspicious, and no fit has been noted, with enuresis occurring spasmodically with free periods between; epilepsy must be considered (Thursfield, 71).

6. Enuresis associated with behavior problems

Some of the behavior problems were discussed under
faulty training. There are many disorders of childhood that are difficult to control. Some of the most common are fits of temper, weeping, negativism, loss of appetite, nervous vomiting, insomnia, night terrors, stereotyped movements and habit spasms, as well as enuresis. Most of these sooner or later disappear. The fact that children are very suggestible makes them readily comprehend the fears and worries of their parents or any upset in the environment. A child that is fussled over constantly is upset both physically and morally; and, if in addition he inherits an unstable nervous system, any bad management will result in bad behavior. A child always shapes his own conduct according to that of those about him, so his early environment is influential. The habit of enuresis, as well as bad habits of eating or sleeping, may result from an unhappy situation such as parental maladjustment and inconsistent methods of handling the child. The child wishes to become the center of interest because of neglect, or he knows an emotional scene will result if he persists in the habit. If the parents fear a failure of cure and convey the idea to the child, even indirectly, the child soon loses his self-confidence, becoming ashamed and unhappy.

Bakwin finds that overattention, as well as neglect, often leads to some behavior problem. If the mother favors another child or if a baby is present, the child may develop enuresis to continue the infantile state as long as possible. Enuresis may also
appear if the child is pushed by his parents to do more work, mentally or physically, than he is able.

Grover (39), Wile (76), and Mohr and Waterhouse (55) note the frequent association of enuresis with nervousness, habit spasms, stuttering, tics, night terrors, thumbsucking and other problems. Grover thinks it the result of neuro-muscular fatigue, but Hamill (40) asserts the disorder is based on the unwillingness of the child to respond to the desire because he does not want to get up in a cold room or because he is afraid of the dark.

In children (Anderson, S) with physical defects, the defect may influence the parents attitude toward the child, causing any behavior problem to be excused on the basis that the child cannot prevent it; or the child may be very sensitive about the defect and feel it inevitable, so loses the desire to cure it.

Illness in itself usually does not produce enuresis, but the attitude of the child and mother toward the illness may be such that the child is given more attention than usual and prolongs the period of convalescence by developing enuresis.

Stealing (Anderson, S) is one of the most common behavior problems. When a child has stolen there results an emotional upset that may serve as a good field for enuresis and undoubtedly this does occur in a few cases. However the two cannot be associated where enuresis persists from infancy.
It is necessary to have an idea of the various personal-
alties found in enuretics to understand their problem. In Anderson's 
series, two thirds of the children were unusually timid. This may be 
a result, rather than the cause, and based on the shame they feel. 
Seventy percent of them were very sensitive to the opinion of those 
about them, sixty percent were aggressive, fifty percent were thought 
to be good mixers and sixty percent had jealous tendencies. Unstable 
emotions were found in three fourths of the enuretics and seems to 
be one of the most constant findings. This undoubtedly accentuates 
the enuresis, but it is questionable whether it is a direct etiological 
factor. The presence of an inferiority complex in some form can 
usually be found if thoroughly sought for but its value is not known. 

It was noted that in two thirds of the homes there 
was some parental maladjustment. The attitude of the parent toward 
the child and his problem also enters in. Parents who expect their 
children to fail discourage the child and make him feel guilty, so 
the opposite effect of encouragement should be sought. Malingering, 
itself, is rare.

In cases where enuresis began after infancy, a sudden 
shock, such as a fright or a fall, was the immediate factor. Anderson 
says that seventeen percent of the cases in his studies showed a 
sudden onset.

In (6) general "whatever the cause of the enuresis, the per-
sistence is almost directly proportional to the emotional stress and 
insecurity" 832.
VII. TREATMENT.

I. Prophylaxis

Prophylactic measures are always of greater value than treatment of an active case. The one method that can be used to establish bladder control is early training. A mother can begin training the child as early as the sixth or seventh month, at least by the twelfth month. In the beginning, it is necessary to concentrate her attention on this problem for a period of a few weeks to two months, until it is properly established as to regularity. Anticipate the time for normal urination and take the child to the stool to keep him dry. It is well to establish definite periods for voiding, such as before and after napping or feeding. Put the child on the stool not longer than five minutes and do not make it an occasion for a scene. Persistence and regularity are the features that will eventually establish voluntary control. There should be no accidents during the daytime after the child is two years old. Night training should be started at eighteen months to two years. It may be well to restrict fluids after five p.m., have the child urinate before he goes to bed, and if necessary wake him at nine or ten p.m. Keep him on the chair until he voids. By the time the child is two and one-half to three years old he should have dry nights. Make the child feel that he has the entire responsibility for keeping himself dry. Relapses are frequent and may be associated with some illness or emotional upset. Patience and re-
education of the child by good training will re-establish the habit. The condition is only aggravated by punishment.

II. Directed toward physical causes

It is necessary to go into the history carefully to determine if there is any pathology present and, if so, treat the condition, whether or not it has a direct bearing on the enuresis. It is necessary to improve the general health of the child for the best results. Aside from the physical aspect it is well to learn the child's habits as to eating, sleeping, drinking, cleanliness, his nervous makeup, the presence of worms or exciting causes. Go into the family history, find out if he has been circumcised, etc. No matter what treatment is used or what regime established, it is imperative that the mother fully cooperates and the child strictly carries out the instructions with belief in the ability to cure.

A. Operative procedures

1. Tonsils and adenoids: These may serve as foci of infection and aid in decreasing the general vitality of the child. Removal is advisable to maintain the general health. Saxl (69) and Moss (61) believe that their removal has an effect in curing the enuresis, but many authors, including Grover (39), Jacobs (46) and Fulton (35) think that it is without effect.

2. Circumcision: An adherent prepuce or long foreskin may require surgery, even though enuresis is not present. Adams (2)
believes circumcision is the only cure while Moss (61) says it often helps, but most writers, such as Grover (39), Chandler (20) and Hernaman-Johnson (42), find it has no effect. Most certainly circumcision should not be a routine procedure as a therapeutic aid.

3. In spina bifida: Delbert and Levi (26) operated on twenty-four cases of spina bifida. The membranous band was resected and as a result ten were cured and ten only slightly improved. There is danger of recurrence with formation and pressure of scar tissue. Leopold (49) also recommends its use.

B. Manipulation

1. One method that has been advocated is injection of saline under the skin in the perineal and pubic regions. Cameron (16) believes its effectiveness is due to counter irritation where there is decreased excitability of the bladder. Serantes and Montes (70) report good results with the use of 30 cc. injected into the perineum and repeated in a week, but Ortiz had no result in two cases. Walker (79) quotes Jaboulay as recommending injection of saline between the coccyx and rectum. Good results with this is reported by White and Martin (61). Normal saline (Cahier 79) is injected around the bladder sphincter.

2. Passing of bougies: Bougies are passed to irritate the mucous membrane and to produce sphincter spasm, making urination painful. Its object is to attract the patients attention to the
process so that during sleep the desire will become conscious and the patient can respond. This procedure is continued until a normal habit is established. Emerson (29) of Boston highly recommends its use.

3. Instillation of silver nitrate: To produce hyperesthesia of the bladder in children who do not experience the sensation of desire to urinate, Weitz and Gotz (4), Lippman (50) and Moss (56) introduce silver nitrate into the bladder. A 1:4000 solution is used twice a week and gradually is increased to 1:750, until a normal habit is established. Lippman reports sixty-six percent of fifty cases cured.

4. Dilation of the bladder: Thompson (70) advocates instilling increasing amounts of fluid into the bladder under pressure to gradually distend the bladder so it can hold more urine. He has the child voluntarily void the fluid introduced and at the same time start and stop the stream at various intervals to strengthen the sphincter. This procedure is to be used only in difficult cases.

Mechanical methods of treatment are seldom used now. With repeated passage of sounds, as with catheterization, there is great danger of introducing an infection. Other methods are less cruel and have as good, if not better, results.

C. Use of electric current

Guyon (3) and many German urologists (35) believed
Enuresis was due to sphincter atony, so applied a faradic current through a special bougie directly to the pars membranacea. Enuresis frequently ceased spontaneously at puberty, thus it may be associated with development of the prostate. On this basis Hernaman-Johnson stimulate the activities of the prostate with electricity and report cures in twenty-five to sixty percent of their cases. They find "almost all were amenable by the application of rhythmically interrupted sinusoidal or faradic currents through the region of the bladder for fifteen minutes daily for a period of from four to twelve weeks" 239. The faradic (Gibbs 35) may also be applied for from three to ten minutes every three to four days by placing the negative electrode against the perineum in the rectum and the indifferent electrode against the lower abdomen. It is believed to increase tone and regulate "vital processes". However, harm may result with indiscriminate use, and it is not generally suitably in small children. It is well to avoid local treatment because it is painful and dangerous. Some assert its effect is only psychic.

D. Epidural injections

Injection of about 10 cc of physiological saline into the epidural space in the lumbar area is used by Emerson (29), Freeman (5) and Cathelin and others, but most writers add it should be given only when other methods of treatment are of no avail. Cathelin, in 1901, explained the mechanism as due to a "pressure effect on the cord
exerted through the fluid, resulting possibly in direct action on
the filaments of the cauda and a reflex tonic effect on the lumbar
centers" 599. There are many reports of success, but Pototsky (63)
warns us of its dangers and bad psychic effects. Though its effect
is based on physiology, it may act purely be suggestion. This method
is not used greatly today.

III. Drugs

Numerous drugs are asserted to have a specific physio-
logical effect, while others are used as an aid in treatment. Their
use is probably the oldest and most frequent therapy. Zappert (80)
lists thirty drugs, all highly recommended. The list is so great
that it is evidence of nonspecificity and something other than drug
action probably enters into the cure.

1. Atropine and belladonna: Atropine sulphate and tinc-
ture of belladonna stand at the head of the list and are recommended
by all except those who present some other particular drug or method
of therapy. It is the one used with most success by the greatest
number of doctors. Cushing (5) states, "Perhaps this action in re-
laxing spasmodic contractions may also explain the beneficial effects
obtained in cases of incontinence in children in which belladonna has
long been the most reliable remedy" 598. Hare, quoted by Wile and
Orgel (76), says belladonna "is a cerebral excitant, a depressant to
motor nerves, and a sedative to sensory nerve filaments" 239.
It has no action on voluntary muscle but is a sedative and anti-spasmodic for unstriped muscle. He believes that as atropine is excreted it has a local action on the nerve endings. Its use is mainly in bladder spasm.

If the drug is given, it is necessary to push it to its physiological effects, so large doses are needed. Thursfield (71) recommends beginning with 10 m. of the Tr. of Belladonna t.i.d. in a child five to six years old, and increasing the amount rapidly until signs of toxicity are present. Moss (56) had good results with 10 gtts. t.i.d. Irwin (44) and Walker (75) begin with smaller doses, but it is administered up to the point of overdosage, then gradually decreased. The toxic effects are mydriasis, flushing, dry mouth and rash. Atropine sulphate is given (Davidson 24, Sicard 67) in a solution of one-tenth of one percent in doses of 5 gtts. t.i.d. (6 years).

Still (8) believes those who have had no effects with atropine fail because the specific indications for its use (pollakiuria) are not kept in mind, a large enough dose is not used, and because it is not combined with training of the child. Failure to cure does not mean that atropine is not specific. Eleyer (10) believes that it is and has eighty percent of cures regardless of cause. This corresponds to the figures given by Ostheimer and Levi. Others, such as Grover (38) and Pisek (61), believe it has no special value, while Fordyce adds its only aid is through suggestion. Regardless of the fact that it
may or may not be specific, cure with any treatment cannot be accomplished unless the patient religiously follows the doctor's instructions.

2. Pituitary extract: Often endocrine therapy is used in nonspecific cases of enuresis on the basis that it increases the tone of the unstriped bladder muscle. However, it is questionable whether a relaxed condition of the detrusor muscle would cause enuresis. A relaxed sphincter would probably be more of a factor. Anderson (5) questions how it can act on one muscle and not on another. To determine the relative effects of atropine and pituitary extract, and determine if there was any specificity, Wile and Orgel (76) selected fifty cases to whom were given the drugs and fifty cases to whom no drugs were given. The table below shows that in general there was no great difference in number of cures in those given atropine and those without. There was a greater percentage cured with pituitrin, but the number treated was only eight so no definite conclusion can be made.

<table>
<thead>
<tr>
<th></th>
<th>Treated with</th>
<th>Treated with</th>
<th>Treated with</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. atropine</td>
<td>No. pituitary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(56)</td>
<td>(42)</td>
<td>(8)</td>
</tr>
<tr>
<td>Cured</td>
<td>19</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>38%</td>
<td>35%</td>
<td>50%</td>
</tr>
<tr>
<td>Improved</td>
<td>17</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>34%</td>
<td>43%</td>
<td>25%</td>
</tr>
<tr>
<td>No effect</td>
<td>14</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>28%</td>
<td>22%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Moss (56) had striking results with gr. 1 t.i.d. of pituitary
extract increased to gr.3 t.i.d. if necessary. Fifty percent were
cured and twenty five percent improved in two to three weeks. He
did not know the basis of its action. Blau (9) reports cures or
improvement in seventy-five percent of his cases and Jacobs cured
sixteen out of forty-nine cases. Blau gives gr. 1/10 - 1/4 t.i.d.
orally with a series of three injections of 1/2 cc. of pituitrin
by hypodermic. The results obtained by Chandler (20) did not in-
dicate that atropine had any value.

3. Thyroid extract: Thyroid extract is given to children
where enuresis is due to dulling of cerebral perception, as in mental
deficients or backward children (Sundell 69). If the mental retardation
is the result of hypothyroidism its administration is indicated and
authorities, as Krafft (48), Irwin (44) Fordyce (31), recommend its
use in such cases. Saxl and Kurzweil (65) note that with definite
findings of hypothyroidism the child has poor bladder control,
more marked during sleep. If the child is hyperexcitable or a poor
sleeper it is not to be used. The usual dosage prescribed is gr. 1/2
t.i.d. to a child under six and gr. 1-3 for older children.

4. Alkalies: Where the urine is definitely hyperacid,
Carter (19), Moss (56) and Sicard (67) neutralize it with potassium
citrate gr. 5-10 q 2 hrs, or sodium bicarbonate, and recommend an in-
creased fluid intake to make the urine less irritating.
5. Vermifuges: The one definite indication for vermifuges or calomel and santonin is the presence of worms.

6. Strychnine and arsenic: If the enuretic child has anemia, malnutrition with loss of appetite, and general muscular weakness, strychnine and arsenic may be given as tonics. Grover (38) had good results when it was used in neuro-muscular fatigue, Jacobs (45) recommends it be given for a long period of time but Blau (9) could find no effect. Large doses, 7-10 minims t.i.d. for a child six years old, given a week at a time is recommended by Thyrsfield (71).

7. Ergot and ergotoxine: Ergotoxine is used by some because it is thought to stimulate the myoneural junction while ergamine acts directly on the unstripped muscle. Its use is explained if the theory of sphincter atony is correct. Smellie (31), Pisek (61) and Holt (76) have had good results with ergot.

8. Sedatives: Phenobarbital and bromides are given to the hyperexcitable neuropathic child, allowing them to obtain the necessary rest. Calvin (15) asserts that phenobarbital raises the threshold of the nervous system, so fear and anxiety aren't factors introduced during sleep. He recommends 1 gr. to a child four to five years old, given for two weeks, then gradually decreasing the dosage.

9. Camphor: Pototsky (63) used camphor in treating the neuropathic type because of its sedative effect on the urinary tract as well as its stimulating effect on the central nervous system.
vascular system. The brain stimulation prevents deep sleep so the child can respond to the sensation of desire. De Angelis reports improvement or cure in six of eleven cases, with camphor injection. Weissenberg says its benefit is from reduced excitability of the bladder and a decreased disposition to disturbing dreams.

10. Tuberculin: Keersmacher (56), on the basis that enuresis is a manifestation of light pulmonary tuberculosis, advocates tuberculin. Amberg (4) suggests its use in tuberculous children.

11. Other drugs: In allergic cases Bray (13) believes eliminating sensitizing products and administration of ephedrin will stop the enuresis. The use of ultra-violet rays alone or together with Vitamin B, and in some cases parathyroid extract, is used by Macchiotta (51) with excellent results. Calcium lactate together with camphor is prescribed by Pototzky (63) because of its influence on the vegetative nervous system and, from the capillaroscopic findings, its influence on vasoneurotic capillaries. Fischer (5) gave testicular extract with success in all but 21 of 500 cases. He found unilateral or bilateral cryptorchidism and thought the extract would be of value. Other drugs that have been mentioned, but which have no special direct effect, are antyprine (Gibbs 35), salicylates (Krafft 48), takadiastase (Radcliffe 5) and glycerine (Ochsenuiss 5).

Cure or improvement is attributed to all the drugs. Thursfield (71) believes no one drug can be relied on, making their use
unnecessary. The experiments of Brum and Kovats (54) showed the results with drugs can always be duplicated in the control group. This is probably because other factors, such as suggestion, are of as great an aid.

IV. Routine Measures

1. Diet and fluid restriction: Diet is not a specific measure but is used as an adjunct with other general methods. Dietary and hygienic supervision are probably the most promising and seem to be of great aid whatever the etiology. It is questionable whether a special diet can cure or prevent enuresis, especially if there is a definite physical basis; but all writers emphasize the well balanced, nutritional diet with no eating between meals as good treatment for any condition. It is well to avoid soups, highly seasoned foods, food rich in carbohydrates, pastry or indigestible foods. Coffee, tea and cocoa should be omitted because of their diuretic effect. Krasnagorski, quoted by Lippman (50), recently recommended a salty diet to retain fluids in the tissues. Not enough work has been done to prove the value of this procedure so no conclusions can be made.

A solid diet for supper with fluid restriction after four or five p.m. and voiding just before retiring to prevent having a full bladder during sleep is a logical procedure. The child frequently wets the bed in the early part of the night. However, Thursfield (71) and Krafft (48) do not restrict fluids because the urine becomes concentrated
and it increases the irritability of the bladder. The former even gives potassium citrate to promote diuresis.

2. Rest: A hyperexcitable, nervous child needs rest, therefore an afternoon nap serves as a good tonic. If a child remains relatively quiet after five p.m., he will not be fatigued and can sleep better during the night.

3. Bladder training: In beginning any treatment it is well to follow a definite regime. One that most physicians accept is to have the child void just before retiring, which should be about seven p.m., then wake him again at ten p.m., two a.m. and at six a.m. Thursfield (71) says to wake the child every three hours. The object is to rouse the child about fifteen minutes before involuntary micturition would take place and thus avoid wetting the bed. It is necessary to wake him at the same time every night until he is trained to waken himself. The act then becomes voluntary. Sundell (69) suggests that it may be necessary to wake him every half hour until the normal time is determined. After a routine has been followed for a considerable time to prevent a relapse, the child learns to waken himself to respond to the desire. Gradually the intervals increase until normal control is established.

Emerson (29) believes the basis of this treatment is training the reflexes by regular periods for emptying the bladder. It changes the conditioned reflex during sleep by bringing the child's
attention to the act and a new conditioned reflex is established through a mental impression of control.

A child should be thoroughly awake when he is voiding. Woolley (78) warns us not to shake him or use a cold sponge, as Chandler (20) suggests, but to wake him by talking and touching him, so he will later wake when spoken to. It is then easier to rouse him in the future. He recommends having the child change his bed clothes and wash them; not as a punishment, though the child may be inclined to consider it such.

In cases of diurnal, or diurnal associated with nocturnal enuresis, the child should be trained during the day as well as at night. Grover (39) advocates training the enuretic to hold more and more urine by gradually increasing the periods of micturition during the day. He believes the bladder is small and can be trained to have a normal capacity. Others, who do not believe a small bladder is the etiological factor, use this treatment as a method of educating the bladder. If the case is severe it may be well to have the child void every half hour the first few days, making sure the time is exact. Then gradually increase the intervals until he voids three or four times a day. Patience and persistence are necessary, but training, both during the day and night, is invaluable treatment.

While the child is urinating it is well to have him voluntarily stop and start the stream several times. Pisek (61), Saxl (65),
Thompson (70), Walker (75) and many others advocate this practice in an attempt to strengthen the sphincter. Success or failure with this treatment, as well as the others, depends on the child's attitude to the process. For this reason, any emotional scene or punishment must be avoided, but the child must be made to realize the responsibility is his. Encourage the child, emphasize his successes in keeping himself dry, and overlook his failures. It may be well to offer him a reward if he remains dry.

The routine methods are universally accepted because they offer the best chance of cure.

V. Psychic therapy

The fact that enuresis has a psychogenic, as well as a physical basis, indicates the value of suggestive therapy. Some cases (Amberg 3) respond to suggestive treatment alone, but most authorities combine it with general measures as well as drugs.

A nervous child is very susceptible to suggestion and a great deal can be accomplished if he can be directed to overcome his fears and establish a dry habit by this method. Its greatest value is in restoring the self-confidence of the patient. Cameron (16) states, "There comes a time when the child passionately desires to regain control and is miserable about her failure, until the concentration of her thoughts on the subject become a veritable obsession" 432. The fear that the wetting cannot be avoided produces a mental conflict
with shame and loss of self-confidence and punishment, which only aggravates the condition. By suggesting that she can cure herself, that it is not hopeless and a disgrace, and by appealing to her pride she can be made to believe she can and she makes an effort at control; not through fear, but from desire and to gain social approval. It is well to employ bladder training at the same time. Encouragement, overlooking accidents and stressing successes are of great aid. To demonstrate the child's progress, a visible record should be kept. Gold stars can be placed on a calendar to mark the successes and red stars for wet nights. Many writers suggest omitting stars for the wet nights, as it may lead to discouragement. Its beneficial effect is through strengthening the desire to have more successes. Rewards also may be offered. It is necessary to make a frequent visit to the doctor to demonstrate the progress and to receive encouragement. The doctor must have the patient's confidence as well as the mother's cooperation.

The rationality of the suggestive treatment, as stated by Wile and Orgel (76) is due to a tightening up of subconscious control on the motor side of conditioned reflexes, which is strengthened by the child's desire to overcome the habit. Walker (75), Sundell (69), Cameron (18), Carter (19) and many others think psychotherapy should be the main form of treatment, because there is failure of the higher centers to control and regulate reflex contraction of the bladder.

The influence of psychotherapy is noted when a child is
taken from his home to a hospital. Here he is made to feel that he is expected to wet the bed, so does not fear its happening and consequently remains dry.

VI. Miscellaneous methods

1. Elevation of the foot of the bed, so that urine will collect at the fundus of the bladder and not produce pressure on the sphincter, is recommended by many and is often a routine measure.

2. A rolled towel or a knot is placed in the mid-back to prevent the patient from sleeping on his back. This method has its basis on the observation that there is greater activity of the spinal centers in the prone position. The child is made to sleep on a hard mattress. He is to avoid heavy covers and keep his hands outside the covers to prevent friction of the genitals.

Lippman places the child in an extreme kyphotic condition for an hour before bedtime on the basis that it enhances diuresis. He then has the child void.

3. Collodion is used by Irwin (44) to seal over the meatus after the child has voided prior to retiring. The child will then waken when he attempts to urinate, therefore he can go to the toilet and have a voluntary emptying. Walker (75) thinks the procedure is "barbarious". He describes a modification devised by Genouville. A complicated electrical apparatus is set up and when a drop of urine falls on a metal plate a bell rings and the child wakens.
4. Bladder massage through the rectum to stimulate the sphincter is recommended by Bleyer (10) and Ullman (76), especially where urgency is the chief symptom.

5. Friedell (32) reports success in eighty-seven percent of 39 cases with a hypodermic injection of sterile water. He combines this with suggestion that it will cure.

6. Gibbs (35) and Cameron (17) mention wearing a urinal for its psychic effect and to keep the bed dry.

When no physical cause is present the following suggestions for treatment are given by Woolley (78, page 50): First parents must "stop all punishment, stop shamming, all arguing and rowing, all displays of intense emotional concern and substitute for them a matter of fact attitude and cultivate an optimistic spirit. Second, the attitude of the child must be changed by eliminating fear, building up faith that success can be attained, stimulating interest in success and developing a sense of responsibility on the part of the child for his own behavior."
VIII. CASE REPORTS.

Diurnal enuresis in a child--treatment with galvanism, Carter (19):

A child, age five, had frequency during the day only. It began two weeks after recovery from measles. Every five minutes he had to void. The patient was treated with increasing doses of belladonna for two weeks, then belladonna and lycopodium for one week with slight improvement. He was then given small doses of iron, and galvanism was applied for ten minutes to the supra-pubic region. After the first treatment the frequency decreased to once an hour; after the second treatment to once in every two and one-half hours; and since then there has been no return.

Treatment with bladder dilatation, Thompson (70):

L. S. Mole, age six years, was incontinent during the day and night. He improved with belladonna and thyroid extract, but the enuresis continued with bed-wetting every night. On January 7, 1921, four ounces of boric acid solution was funneled into the bladder through a catheter and the belladonna continued. The next week he held six ounces of boric acid solution for eight minutes; the following week, eight ounces (only wetting the bed three times during the week) and the week after that he did not wet the bed at all. Seven ounces of boric acid was used and the belladonna discontinued, while malt and
iron were given. The patient continued to improve and was apparently normal in April.

**Treatment through suggestion, Emerson (29):**

Fred R, age nine, had the usual history of enuresis. He was punished by a matron with temporary improvement, but complete recovery was made through encouragement and rewards, the basis being that rewards stimulate the attention while punishment introduces fear which is repression.

**Treatment with routine measures, Pisek (61):**

N. S. C., age three and three-fourths years, had always wet the bed since birth, also during the day. There was never a dry night. They tried the usual remedies without success. Otherwise the child was normal and well with a good mentality. No drugs were given, but he was treated with a good diet, restricted as to fluids, given bladder control exercises during the day and wakened at ten thirty to urinate. In three weeks he was dry fifty percent of the time and during the following week only occasionally did he wet the bed or his clothes. In three months he was entirely cured.

**Neuro-muscular fatigue as a factor, Wylder (79):**

J. S., age twelve, had normal health. He had not had
enuresis until recently. When school closed he worked on a ranch and was exhausted every night. He developed enuresis and wet the bed two and three times a night. He was told to stop work and stay in bed for a few days. The first week he had three dry nights; the next, seven dry nights and he has had no trouble since.

Psychogenic basis of enuresis, Bakwin (8):

George, age six years, had voluntary control at eleven months. He was normal until four months ago. The bed-wetting was irregular and none occurred during the day. Facial twitchings began at about the same time as the enuresis and were noted especially during meals. Physical examination was negative. The urine was negative. There were two other children in the family, with a girl the favorite. George was jealous of the attention to his sister, so to get attention attracted to himself twitched and wet the bed as a revenge for neglect. Treatment was given in the form of suggestion and a sedative (\(\frac{3}{4}\) gr. luminol t.i.d.). He was told he could be cured and the parents did not discuss the matter when he was around. Immediate cure followed.
X. SUMMARY.

1. Enuresis is involuntary emptying of the bladder. The most common form is nocturnal; the next, nocturnal and diurnal combined.

2. The incidence, as given by various authors, varies from five to thirty percent. The onset is in infancy or after a normal period of control. It is equally distributed among the sexes, though it may be slightly increased in boys.

3. There is undoubtedly a physical basis in some cases, producing a disturbance in bladder physiology, either local, nervous or general.

4. The psychogenic factor plays an important role, as evidenced by the success obtained with suggestive treatment.

5. Other factors, such as heredity, epilepsy and behavior problems, may have their influence.

6. Look for physical defects and correct them.

7. Improve the general health by good diet, hygiene and tonics.

8. A large number of drugs have been prescribed, but atropine or belladonna and thyroid and pituitary extract seem to be the most favored.
9. Routine methods of treatment; including a good diet, fluid restriction, rest and bladder training with good habit formation; are generally used in conjunction with other forms of therapy.

10. Psychotherapy which restores confidence and encourages the patient is invaluable. Cooperation, persistence and assurance of the ability to cure may be the key to the success of most forms of therapy.

CONCLUSION.

From the foregoing it is obvious that there is no uniformity of opinion as to the etiology. It is undoubtedly a reaction to a wide variety of stimuli, physical and mental, that may be effective for a short or long period of time. The multiplicity of suggested treatments indicate that none are specific. Cures are reported with all types of therapy, while no results are obtained by other investigators using the same methods. Every child offers a different problem, making a thorough study of each case essential.
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