

1935

Enuresis

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E N U R E S I S

A SENIOR THESIS

University of Nebraska
Medical College

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April 26, 1935.

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INTRODUCTION

Much has been written but relatively little is known of this condition which distresses mothers, shames children, and frequently baffles physicians. (Davidson 29).

Burnett (18) says that it is a very common and familiar condition in pediatrics. It is one which taxes the physician to the utmost in order to bring about a cure. 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 mental and moral development.

Mandell (61) describes it as one of the most irritating and difficult problems of medicine. The problem of enuresis is really a problem of deranged micturition, even if some of the therapeutic measures are not directly concerned with the restitution of a proper bladder control, but seek to avoid the wetting of clothes and bed by influencing the filling of the reservoir, or by taking up the children during the night to prevent overflow; ceases around puberty in most cases. In many cases bed wetting is a cause of or precedes the neurotic traits.

The early ideas on enuresis are interesting because of the nonspecific remedies which were used. Boerhaver & Caspar (25) recommended burning of the skin with hot irons; blows on the buttocks with the palm of the hand to get an ischemia; the passing of sounds and cautery.

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Foster (25) in 1860 had several cases of gangrene of the penis due to the tying off of the organ in trying to cure enuresis. Lallenmond in the 19th century recommended aromatic baths for one hour daily.

Chandler (23) found that during the 17th and 18th centuries when the medicine of the day was saturated with mysticism the treatment was often of a bizarre nature; various contrivances were supposed to be worn about the neck; the bed was made to face in certain directions, etc.

Dunham (30) quotes an old Saxon chronicle: "The Magi taught the patient suffering from this disorder to drink the ashes of pig's pizzle in sweet wine and so to make water into a dog's kennel adding the words--lest I like a hound should make urine in my own bed."

There are no early theories about the causation of this disorder except those which are outlined under the section on etiological factors. Eustace Smith, West, and Sachs (25) were among the first to sense the modern conception of the pathology of this disorder. Sachs in 1896 called particular attention to training of the nervous system as a cure for the affection.

Adams (5) presented the first paper on enuresis at a medical meeting before the meeting of the American Medical Association in 1885 and remarked that it was high time that such a paper was presented before a body of physicians. He stated, "----- all cases which have come under my attention have had specific causes and were not the effects of laziness."

DEFINITIONS

Enuresis is defined differently by the various authors who write on the subject, each one defining the term more or less according to the conditions present in his group of patients or in line with his views on the subject. The two major medical dictionaries define the term as "the involuntary passage of urine".

Davidson (25) defines enuresis as 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 pathology.

Campbell (20), a urologist, calls it the unintentional or involuntary nocturnal or diurnal urination in the absence of demonstrable uropathy.

RocheFord (116) takes the view that it is a true neurosis, and is not as a rule due to muscular incompetency of the sphincter vesicae. It is commonly associated with other nervous symptoms, with anemia and with reflex irritation.

Bleyler (7) divides enuresis into two classes: 1. Enuresis vera--that type of enuresis in which dissociation between the brain and voluntary nervous system, as concerns the physiology of micturition, actually appears to exist; and 2. Pseudo-enuresis--reserved for that type of defective control which can be relieved by measures designed to influence the will or to obtain the cooperation of the child.

Muldawer (55) reasons that enuresis is not a disease in the accepted sense of the word; nor is it a symptom, for in the latter case it must have a disease accompanying or preceding it.

From these various definitions presented, it can be seen that enuresis is not a homonogeneous disease, but merely a symptom of some condition which requires analyzing.

In the study of a large number of normal children, Andersen found that the following were normal figures in regards sphincter control in children:

bowel control at 14 months
diurnal bladder control at 17 months
nocturnal " " at 23 months.

Most authors, however, do not make a diagnosis of pathological enuresis in any children underthree years of age.

PHYSIOLOGY OF MICTURITION

A discussion of enuresis would not be complete without some mention of the physiology of micturition, and for this reason we shall present some of the modern concepts of this complex process which are agreed to by most writers and experimenters working on the problem.

Brown & Robertson (13), Mandell (61), Elliot (95), and Barrington (88), all agree that the bladder reacts to distention by contraction of its wall; that filling of the bladder is an involuntary function demanding a relaxed wall and tight sphincters; that the filling center is in the twelfth thoracic and first two lumbar segments of the cord; that the desire to urinate arises from stimulation of the sensory nerves of the bladder and not from stimulation of the sensory nerves of the posterior urethra; that the external sphincter is capable of maintaining bladder closure and does not have to be educated to perform this task and that either the external or internal sphincter may be destroyed without interfering with function providing the remaining one is in a normal condition.

These men further agree that emptying of the bladder is a voluntary process and has a center in the lower segments of the cord but is linked up with the cerebrum. In micturition sensations of distention reach the cord, the trigone and vesical wall contract, the internal sphincter relaxes, and then follows the voluntary phase: the sphincter relaxes and

urine is expelled. Then, when the bladder is empty, follows the closure of the involuntary sphincter, the the external sphincter, and finally the bulbocavernosus and urethral muscles contract and expell the last few drops from the urethra itself.

Mc Clintic (53) puts the bladder in the same general category with the uterus and anus in that they all combine a voluntary and an involuntary mechanism. The sphincters are of two kinds voluntary and involuntary. Visceral muscles do not fatigue under normal conditions so that the involuntary sphincter of the bladder can remain closed for a long period of time and after a brief rest (while the bladder empties) it is again ready for work. Voluntary muscle fatigues quite readily in a contracted state so that the external sphincter and bulbocavernosus muscles are at rest except during the time when there is a desire to urinate, a very necessary coordination of muscle balance.

It is further agreed that the pelvic nerve (parasympathetic) (second to fourth sacral) is motor to the detrussor muscle, producing contraction of this muscle and relaxation of the urethra. Barrington (88,89,90) has shown that in the cat there is a motor tone passing to the bladder through the pelvic nerves which arise in the central nervous system above the level of the lower thoracic region in the cord. He also showed by section of the cord at various levels that this level is at or near the middle of the pons. This latter piece of work was corroborated by Donahue (28).

The hypogastric nerve (11th thoracic to 2nd lumbar) is at

least theoretically inhibitory, and it has been shown in the cat (Elliot 95) that a complete antagonism of action exists between these two nerves. Probably it is the normal tonic contractions of the urethra that maintains the urine in the bladder.

Chetwood (93) says that in children the detrussor muscles of the bladder are relatively thick and strong as compared with the sphincters, and therefore the bladder may empty with great ease. Holt (45), Griffith & Mitchell (102) and Moss (57) report the same finding to be true.

During infancy the lower centers only are involved in defecation and micturition and that as the nervous system develops there is an increasing control over this lower center and that complete function can be hastened through education by repetition. It is probable then that in children who continue this infantile process of urinary evacuation, the conducting paths function but in part and during sleep, the inhibitory stimulus is lacking.

In sleep the sympathetic system is supposed to be at rest as shown by the predominance of vagal impulses; narrow pupils, slow pulse, slow respirations, etc. Hence we expect to find a predominance of sacral impulses in relation to the bladder. Dr. Henry Pleasants regards enuresis as overabundance of these sacral impulses.

INCIDENCE, TYPES, CLASSIFICATION, ETC.

INCIDENCE--The only figure available as to the prevalence of enuresis in a pediatric practice or dispensary is that reported by Davidson (29), who went back into the records of the Harriet Lane Children's Dispensary of Baltimore for a ten year period ending 1922, and found that 591 children out of a total number of 35,128 came to the clinic with enuresis as the chief complaint. This is an incidence of almost two out of every one hundred children.

Every author who writes on the subject says that enuresis is a very common complaint in pediatric practice but none venture any figures as to the relation to other complaints. We have no idea as to how frequently we find a history of enuresis in patients who come to the doctor for other complaints, and also how many mothers never pay any attention to this minor complaint.

Sheldon (120) made an inquiry of 5000 children between the ages of 5 & 15 years, in the poor-low class homes, and found that about 5% were enuretic.

Steele (117) reports an incidence of 15% in The Children's Village at Dobbs Ferry on the Hudson, New York, regarded as a model child institution. At the Wayne County training school he found 143 enuretics in an admittance of 1400, a little over 10%.

In going over the figures reported from several children's institutions we find an incidence varying from 7 to 80%.

Andersen (3) reports an incidence of 15% in three institutions with a combined population of 121; Dunham (30) reports 7% of 800 children admitted to Phipps Institute for nervous children from 5 to 16 years of age; Jacobs (106), 2% in an institution of 450 girls and 16% in one of 650 boys; Adler, 8% in a home with a population of 900; More & Waterhouse, 17% in the Norwegian Lutheran Home with a population of 90; and Lewis who reports an incidence of 80% in a model institution for children between 3 and 4 years of age, with a population of 40.

TYPE-- From the following table it is evident that nocturnal enuresis is the most common type:

<u>Author</u>	<u>Nocturnal</u>	<u>Diurnal</u>	<u>Both</u>	<u>Number Cases</u>
Andersen (3)	79%	3%	18%	148
Beverley (12)	Most	-	---	250
Campbell (20)	98%	2%	---	330
Blau (10)	69%	2%	19%	90
Davidson (29)	34%	2%	64%	210
Zappert (29)	30%	-	70%	40
Fordyce (37)	44%	-	56%	?
Holt (45)	40%	5%	55%	?
Still (45)	52%	4%	44%	?
Muldawer (55)	68%	2%	30%	110
Usher (78)	63%	-	37%	?
Schwarz (121)	60%	2%	38%	226
Wile & Orgel (133)	52%	20%	28%	100
Grover (100)	59%	3%	38%	200
Averages are about:	60%	3%	37%	

AGES--The following age incidence of Campbell's 330 cases will represent a cross section of the figures reported by the other writers on this subject:

5 years and under	38 cases	or 11%
5 to 7 years	106 "	32%
8 to 10 "	136 "	42%
10 to 15 "	50 "	15%
	<u>330</u>	<u>100%</u>

The figures just quoted show the ages at which the patients consulted the particular clinic, the following set of figures will reveal that in over 60% of the children enuresis had persisted since birth:

Davidson (29)	79%	since infancy,	21%	acquired
Campbell (20)	67%	" "	33%	" "
Grover (100)	86%	" "	14%	" "
Fordyce (37)	60%	" "	40%	" "
Andersen (3)	83%	" "	17%	" "
Hubert (42)	58%	" "	42%	" "
Thomas (76)	65%	" "	35%	" "

BOYS AND GIRLS--The prevalence of enuresis is somewhat more in boys than in girls, the average figures being about 5 boys to every 3 girls.

RACE--Andersen's work showed that all races were represented and that any predominance of one race was due to the fact that the population of that race in that particular section was greatest.

INTELLIGENCE--Again we quote from Andersen who was the only author who went in for intelligence testing on any great scale. He found the same general curve in his enuretics as he did in his normal controls.

SUMMARY--In summing up the material presented in this chapter, it is seen that the incidence of enuresis is almost 2% in the general practice of pediatrics; that in institutions enuresis is a greater problem, being present in about 15% of the population; that nocturnal enuresis is by far more common than diurnal; that most of the enuretics have been so since infancy; that it is not common to any particular race; and that intelligence is not the determining factor in this complaint.

ETIOLOGICAL FACTORS AND CLASSIFICATION OF CASES

In trying to find a specific cause for enuresis in their respective patients, the various investigators during the past twenty-five years have blamed everything from eye strain to flat feet, and justly so, because there are no specific etiological factors which can be applied ^{to} every enuretic child, but there are many contributing factors which can be determined in most enuretic children, and it is this group of findings which will make up this chapter of the paper.

In going over the literature one finds many different classifications of the enuretic children; these are based for the most part on the respective views of the classifier or upon the particular group of patients which were examined. One which fits all possible etiological factors responsible for enuresis is that of Ruhrah (135), which will be followed as a general guide. Strong evidence in favor of or against any of these theories which has been worked out by different investigators will be presented. His classification is as follows:

1. Physiological--due to the taking of too much fluid,
2. Eliminative--due to faulty metabolism,
--eating too much salt, etc.,
--due to the taking drugs,
3. Urine abnormalities--hyperacidity,
--hyperalkalinity,
--bacteriuria,

4. Genito-urinary pathology--

- a. Inflammations--cystitis
 - urethritis
 - pyelitis
 - balanitis
- b. Malformations of all kinds,
- c. Calculi,
- d. Tumors,
- e. Hypertrophy,

5. Nervous System

- a. Hypertonia or irritability of bladder,
- b. Weakness of sphincter,
- c. Reflex--balanitis
 - vulvovaginitis
 - anal fissure
 - rectal polyps
 - intestinal worms,
- d. Malformations of cord,
- e. General irritability,

6. General causes--

- a. Diabetes Mellitus
- b. Diabetes Insipidus
- c. Rachitis
- d. Thyroid misfunction
- e. Adenoid and tonsil pathology.

1. Physiological--The taking of too much fluid is rarely found to be a cause of enuresis. It is true that most all of the various treatments for the condition include the limitation of fluids after certain hours, but this procedure alone has not been found to be enough to cure the practice in an individual.

2. Eliminative--Faulty water metabolism may be a contributing factor to enuresis, but in itself has never been proven to be the sole factor. In most of the treatments of enuresis the salt intake and condiments in the diet are greatly curtailed. There is no specific rationale for this procedure except as to indirectly cut down the desire for water and other fluids. Constipation has been mentioned as a contributing factor, and truly it may by its general effect on body metabolism.

3. Urine abnormalities--Hyperacidity has been reported to be the only finding in certain cases of enuresis, but Anderson's and Campbell's work and others have shown that hyperacidity is present in as many normal controls who do not suffer from enuresis. The same has been shown to be true for alkaline urines. Friedell (98) found that in three of his cases who did not respond to treatment with hypos of sterile water, that there was a reversal of the normal concentration of the night urine. He found that in these three cases the specific gravity of the night urine was lower than the day urine. This finding was reported by no other writer on the subject. Bacilluria has been reported in many enuretics. Fleishner (97) found 20% of his cases to be due to the colon bacillus infection. Campbell found pus in the urine of 107 out of 188 of his patients, albumin in 73, and blood in 7.

4. Genito-urinary pathology--In 100 children referred to Dr. Butterfield (9), a urologist, 37 were for enuresis. Dr. Hugh Young reports that enuresis is by far the most common complaint for which children are referred to the urologist. The most comprehensive piece of work in urologic diagnosis was that done by Dr. M. F. Campbell (29) in the children's division of urology in the Bellevue hospital. In 330 children who had clinically been diagnosed as enuretics, and in whom medical, physical, and psychotherapy had failed, complete urological examinations were carried out. Of interest is the following urologic diagnoses which he made:

Functional	99	Trigonitis	
Neurogenic	31	(only lesion)	45
Cord Bladder	15	Cystitis	5
Phimosis	4	" with edema	3
Atresia meatus	15	Renal infection	26
Urethral stricture	5	Pyelonephritis	19
Urethritis	7	"-osis	1
" due to masturb.	6	" due to t.b.	1
Caruncle	1	Hydronephrosis	5
Posterior urethral valves	25	Ureteral stricture	
Large verumontan.	18	(only lesion)	1
Inflamed "	16	Vaginitis	10
Papilloma of "	4	Hypertrophy of labia	
Prostatitis	24	due to masturb.	5
" of masturb.	16	Diabetes mellitus	1
Contracted bladder neck	19	Diabetes insipidus	1
		One each of the following:	
		hypertrophied clitoris, acrocephaly,	
		exophthalmic goitre, hydrocephalus,	
		traumatic spinal cord disease,	
		pulmonary tuberculosis, pin worms,	
		ocular ptosis, flaccid lower trunk	
		and extremities, and one cretin.	

In going over this list one is impressed with the fact that 80% of the patients showed uropathy, a very high figure. But Campbell's cases represent only a small number of the total enuretics seen by all of the clinicians. He is of the same opinion as the rest of the investigators, however, namely that about 90% of the enuretics are on a functional basis (this will be discussed later on in this chapter).

Thomas (76) found enlargement and congestion of the verumontanum in 40 out of 115 patients referred to him on account of enuresis and cured half of these by fulguration of the body.

Campbell's cases exhaust every possible cause for enuresis given in Ruhrah's classification.

5. Nervous system-- I shall reserve this discussion for the end of this chapter and shall use Wile & Ogel's classification, which is more complete.

6. General Causes-- Every once in a while Diabetes mellitus or insipidus is found to be the sole etiological factor in an enuretic child. This diagnosis is easily made and the enuresis controlled by treating the disease. Campbell had one case of each in his series.

Rachitis has not been blamed by any of the writers.

Tonsils and adenoids have been blamed by all of the early writers, but removal of these rarely in itself cured the condition. Ruhrah (135) quotes Fischers 714 adenoidectomies, in which there was a history of enuresis in 15 %. Mygind reports 8% in 400 cases. Campbell found diseased tonsils in 27 of his cases, over 60% had had their tonsils out previously. Andersen reported over 70% of his cases had had previous tonsilectomies.

Hypothyroidism has been shown by Williams(130) to be a very common cause of enuresis, and attributes the success of thyroid extract therapy in the hands of various physicians to this diagnosis. Adler (87) recognizes the hypothyroid by his deficiency in height and weight, his persistently low temperature, the dryness of the skin and appendages, the improperly placed teeth, adenoids, flat chest, and polyuria. A basal metabolic test would be an additional and valuable diagnostic aid in enuretic patients. Thus far no one has reported any such findings in the literature.

General malnutrition has been mentioned as one of the causes for enuresis. Ninety-eight of Campbell's cases were undernourished and looked sickly, but he does not say whether these were some of the patients who exhibited uropathy or were some of his functional enuretics. Andersens series does not classify the cases as to the nutritional state. Adler says that the nutrition state is very much related to the general body tone and in this way indirectly related to enuresis as the muscular tone of the bladder is affected.

Amberg (10) believed that enuresis might be due to a deficient capacity and pressure in the bladder and set out to prove his assumption. He measured pressures and capacity of bladders of 19 enuretic patients, 14 of whom were under 10 years of age, and came to the following conclusions:

1. There was a decreased pressure of the fluid in the bladder;
2. There was a decrease in the discomfort of the distended bladder; and
3. There was a decreased capacity of the bladders.

Amberg's work has not been proved or discredited by anyone as yet. His experiment presents several technical difficulties and he did not run any normal controls.

Chronic constipation has been mentioned by about one third of the bibliography as a contributing factor and this condition is always kept in mind when treating.

Other miscellaneous findings in enuretic children to which the condition has been attributed are eye-strain, syphilis, various skin diseases, anemia, headaches, ulcerative colitis, hernia, scaphocephaly, pulmonary tuberculosis, circumcision, preputial adhesions, various physical defects per se, masturbation, and heredity.

NERVOUS SYSTEM

The nervous system is blamed by most authorities for the symptom complex of enuresis. Most all agree that 90% or more of the enuretics are on a functional basis. Wile & Orgel (133) have arranged a nice classification which I will reproduce:

I. Peripheral nervous system

1. Malformations such as epispadias, ectropia vesica, hypospadias, patent urachus, vesico-rectal fistula, phimosis, and small meatus.
2. Trauma, inflammation and new growths.
3. Metabolic--acid urine, constipation, endocrine, and diabetes mellitus.
4. Reflex--pin worms, vulvovaginitis, fissures, polyps, masturbation, and pertussis.

II. Spinal

1. Malformations--spina bifida occulta

2. Inflammation--Pott's disease, myelitis.
3. Reflex--hyperirritability of spinal cord.

III. Cerebral

1. Organic

A. Malformations and retarded development

- a. Mongolism
- b. Cretinism
- c. Infantilism
- d. Idiocy

B. Diseased states, trauma, new growths, chorea, chronic meningitis, epilepsy, hydrocephalus, and diabetes insipidus.

2. Functional

A. Metabolic--general debility, malnutrition, rachitis, intoxication, and pathologic sleep.

B. Psychic--neurasthenia, dreams, hysteria, neurosis, psychosis, weak attention, weak will, worry and anxiety, fear and malice.

The first third ~~of third~~ of this classification has already been taken up as included in Ruhrah's classification.

Spina bifida has been mentioned by about 20% of the bibliography as the sole cause for the enuresis. In Campbell's series there were 34 cases with spina bifida occulta out of 201 cases X-rayed, an incidence of 17%. West (129) carried out an experiment on enuretic soldiers and found 41 out of 81 to have spinal defects, an incidence of 50%, 13 having more marked pathology. In 100 normal controls he found 48 with spina bifida occulta,

21 having a marked degree. We see an equal distribution of spina bifida occulta in persons not suffering from enuresis. None of these showed any of the physical signs such as hair over the area, skin tags or dimpling. Of the many of Davidson's patients who were X-rayed, only 4 showed any degree of spina bifida. Fuchs (87) found 68.2% of spina bifida in adults, and 35% in children suffering with enuresis. Standard textbooks of radiology give an incidence of as high as 20% being normal for spina bifida in adults.

Pott's disease and myelitis may cause enuresis and here the condition is more one of incontinence. The neurologic findings are characteristic and the condition is easily diagnosed.

Wile & Orgel mention reflex hyperirritability of the cord as a possible cause, but do not give any methods of detecting this possibility.

Mandel (61) enumerates the following factors which may render the spinal cord more irritable:

1. Overtension as seen in diabetes mellitus, diabetes insipidus, etc.,
2. Direct reflex stimulation within the bladder such as cystitis, acidity, etc.,
3. Influences from outside the bladder such as phymosis, malformations, vaginitis, etc.

The incidence of enuresis in institutions was seen to be rather high; this is attributed to the number of cretins, mongols and various feeble-mindedness which is observed in most of these. The reasons why enuresis should be more prevalent in this group of people has already been brought out in the chapter on the physiology of micturition.

The various organic cerebral states which Wile & Orgel have classified have already been discussed, the enuresis being due to interruption of the normal micturition reflexes somewhere along their path.

We now come to the psychic aspects of enuresis, to which some 90% of the cases are attributed. Pototzky (113) says that all of his children are nervous and divides them into the following four groups:

1. Obstinate children whose lack of inhibition is due to desire to annoy parents,
2. The highly anxious children who have undue fear of punishment,
3. The children with decreased capacity for attention and concentration, and
4. The children excessively indifferent to all forms of impressions.

Melleo-Leiato (110) says he has three kinds of patients:

1. Children who are too lazy to rise from bed,
2. Children who sleep so soundly that the warning of a distended bladder is not heeded, and
3. Children who dream they are passing urine.

He also defines two varieties of enuresis:

1. Atonic--lack of tone in the external sphincters,
2. The irritable--in which there is an exaggerated sensitiveness of the bladder.

Pisek (111) says that children with unstable nervous equilibrium from chorea, epilepsy and similar conditions are prone to incontinence of urine; that it is a sign of neuromuscular fatigue

in children who play hard.

Lewis (50) conducted an experiment in which he psychically induced enuresis. He brought on enuresis in children 3 to 5 yrs. old by transferring them from large dormitories to individual cubicles. It was transient in some, lasting only 48 hours. In others no adjustment was made in the seven days observed, but promptly ceased when brought back to the dormitory.

Courtin performed various tests on 56 children including 13 boys and 2 girls who were enuretic, and failed to show any connection between especially deep sleep and the incontinence of urine.

Donahue (28) quoting Phillipport says boys who are subject to enuresis are ordinarily affected later by seminal losses and may become genital or urinary psychopaths, not in consequence of the incontinence itself but of the original defects which during their early years was the determining cause of their infirmity and which continues its influence.

Andersen found a history of masturbation in 63% of his boys and in 30% of his girls, but comments on the fact that he found an equal number of each in his normal controls. Thomals tells us that enuresis is always present before the ages at which masturbation first manifests itself.

Wachenstein (101) relates enuresis to the tics or habit spasms, because both show the following characteristics:

1. Habituation
2. Being almost continuous
3. Less frequency during the day because all habit spasms are temporarily suspended when the patient's

attention is called to it

4. Frequently associated with stuttering.

Heredity is supposed to play a part. Grover (100) found a family history in 56% of his 200 cases; Hubert in 40% of his cases; Horton in 56% of his 40 cases; Fordyce in 25% of his 40 cases; Andersen in 15% of his series.

Many of Andersen's children showed one or more of the various nervous traits seen in children; 70% had tantrums, 60% nailbiting, 36% thumb-sucking, truancy 30%. Twelve percent of Wile & Orgels cases showed thumb-sucking and nail-biting.

Sixty percent of Hortons cases were nervously unstable; as were 75% of Andersens series, showing symptoms of shyness, fear, timidity, and temperamental traits.

Steele (117) quotes a communication from the director of the Children's Village in which he states that "Every institutional child is a potential enuretic." He explains this by the fact that the child feels that he has been deprived of the normal home contact to which he is entitled and harbors a spirit of resentment towards the institution which prevents him from enjoying this privilege. He therefore proceeds to salve his irritation by literally "peeing" on the institution.

Rocheford (116) says that incontinence of urine in children is a true neurosis, and is not as a rule, due to muscular incompetency of the sphincter vesicae. It is commonly associated with other nervous symptoms, with anemia and with reflex irritations. He bases this conclusion on the following facts:

- a. In children reflex causes are more common than in adults such, for example, as uncorrected eye strain, adherent

prepuce, balanitis, adenoids, hypertrophied tonsils, constipation, etc.;

- b. the nervous system of the child is more irritable and unstable by reason of its incomplete functional development;
- c. the inhibitory control of higher nerve centers on spinal reflex movement is feebly developed in the child; and
- d. blood changes are much more common allies of reflex disturbances in producing nervous diseases, in children than they are in adults.

Muldawer (55), after a study of 100 cases, came to the conclusion that all enuretics are vagotonics, and that the whole autonomic nervous system is involved. He quotes Eppinger & Hess' description of a vagotonic. The vagotonic calls at the office complaining of dyspepsia, fear of heart failure; he looks like a nervous invalid; he is hasty and precipitous; the color of the face changes from flushed to pale especially when asked to undress and when he does you notice the skin has blotchy areas of redness. The hands are bluish red, at times cyanosed, damp and cool. Perspiring easily, you may see sweat running down from the axillae. His eyes are large, often beautiful; he is always swallowing; there is an increased activity of the salivary glands; the tongue is fissured; the pulse is slow; he is constipated; the reflexes are increased; the Chvostek sign may be positive; and he is usually ill at ease.

Grover (100) says that enuresis is the result of a general body muscular fatigue.

Wooley (31) gives an excellent analysis of the functional causes for enuresis, which is here reprinted:

1. Postponing the natural period of training so the habit of reflex micturition becomes firmly fixed without regard to circumstances. The 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, with 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 for his own care.

Carter (25) picks out the four following types of children who are subject to enuresis:

1. The neuropathic child: he is hypersensitive, responds to the slightest stimulation, especially cold water, running water, cold air, water dreams, etc.
2. The psychopathic child: he keeps wetting the bed due to the fright instilled, continues his absent-mindedness in sleep, fails to understand what the reproaches are about, and bed wets to spite admonitions, and also day wets himself.
3. Fetalistic--due to the retarded development of the child in age.
4. Pathocrinal--the hyperthyroid type.

Summary: The various etiological factors which contribute to the formation and continuation of the enuretic habit have been presented in this chapter. It will readily be seen that there are very few, if any, specific causes for the condition and that the great majority of cases are on a purely functional basis.

TREATMENT

A discussion of the therapy of enuresis can well be taken up under three convenient divisions, namely:

1. suggestion,
2. medicinal, and
3. mechanical and surgical.

SUGGESTION: As Dubois (30) long ago suggested "enuresis may be cured by education only, interrupting the child's sleep for this purpose in the middle of the night. It is thus that good habits are created. Success depends on the ability to change the situation which, during sleep, stimulates a primitive state controlled by an unconditional reflex mechanism. Granted favorable circumstances, all that is required for a positive effect is the ability to awaken attention, thereby establishing associative control through a conditional reflex. By presenting repeatedly a definite stimulus, the bladder is reeducated in a proper method of functioning. The form in which this associative suggestion should be presented depends on the point of view of the observer."

Davidson (29) says that the majority of the patients can be cured or improved if practically any treatment is persisted in. He says that 15% of all cases are unaffected by treatment. Most, however, acquire control at puberty.

Hammill (103) says that it is the assumption of the responsibility by the patient for his performance which is the important factor in suggestive therapy. You establish the patient's confidence in his ability to be cured, either in his

faith in the instructions given or through his reliance on the drugs prescribed. The cooperation of the parents is also very necessary. Arouse the child's play or game instinct in some manner of keeping a record of his performance; also rewards for good conduct.

Dunham (30) comments on the therapy of enuresis as follows: "Successful treatment of these patients with empirical remedies is frequently as surprising as it is inexplicable. The element of mystery thus added temporarily enhances the virtue of the cure until its failure for each and every case rellegates it to the limbo of the charlatan, another nostrum taking its place."

Steele (117) reports cures in 112 out of his 140 cases by simply awakening the child and calling him to toilet. This is equal to 78% of the total number. Twenty two percent reverted back when he quit calling them, the rest were cured.

Dunham (30) suggests that the child carry around a card with the following inscription on it:

1. I will not wet the bed.
2. I will wake up at ten o'clock.
3. I will get up and pass water.
4. I will not wet the bed anymore.

This is to be repeated at every diurnal urination and again before going to bed.

Removal of diapers and going to the bathroom "like daddy does" is suggested by Andersen.

Regular urination periods have been recommended by Fordyce (37), Wachenstein (131), Herman (43), and very many others.

With the above preliminary remarks in mind I shall outline

what is known as the routine measures. This outline, either wholly or in part, is followed by practically all men who treat enuresis regardless of what their pet theories as to the etiology.

1. If there is^a contributing factor which is affecting either the general health or nutrition of the child, it is very logical to treat this condition also.

2. The fluid intake should be stopped at 5 p. m. It has been proven that when any great quantity of fluid is ingested the greater proportion of it is eliminated into the bladder within three or four hours. In this way most of the fluid will be in the child's bladder before bedtime.

3. The child should be made to void his urine just before going to bed.

4. Then the child should be gotten up two hours later, completely awakened, and taken to the bathroom to urinate again. This procedure gets rid of the urine which had not been excreted when the child was put to bed. Emerson (35), Calvin(31), Usher (78), and many others are agreed that this is enough to cure from 30 to 40% of all their cases.

5. An afternoon nap is advisable. There has been no rationale suggested for this other than a tonic effect.

6. No competitive games, vigorous exercises, or exciting radio programs are allowed after 6:00 p. m. This advice is given on the beliefs that excessive fatigue before bedtime makes for a more sound sleep and any call to urination would be less likely to be heeded.

7. Condiments and sweets are forbidden after lunch time, purely on empirical reasons.

8. All punishment is stopped.

9. All arguing, babying, rowing, etc. is forbidden. It is believed that focusing too much attention to the condition is a contributing factor in keeping up the bed-wetting. The child should not be repeatedly reminded of his deplorable habit. The problem is to dissociate his subconscious mind from the process. The mother and brothers and sisters should be cautioned not to even mention the matter of bed-wetting in the presence of the child. Numerous cases are on record where a cure was effected merely by the abolishment of the focusing of attention to the enuretic child, and simply forgetting about the situation.

10. Arousing the child's interest in clearing up his condition by some manner of keeping a record of his progress. The best method for younger children is the gold star method. The mother is given a small calendar with enough gold stars to last until the next visit. Each morning the child is to come to his mother and report if he is to get a gold star or not. Some men recommend a red star for failures to have a dry night, but it is argued that the presence of a red star would call the attention too often to failures and not to the successes. It is probably best to leave the wet days blank on the calendar so that when the child looks at the record he will be reminded only of his successes.

11. Periodic visits to the physician. These should be weekly until the child is well on the way to recovery, and then the interval can be gradually lengthened. At these visits the child is to be praised for his dry nights, reassured that he is doing fine, and will soon be completely cured.

Stronger suggestive therapy in the form of hypos of sterile water have been used by some men. Usher (78) reports cures in 24 out of 45 patients by the injection weekly of sterile water and the assurance that this will effect a cure and warning that if relapses occur additional injections will be needed. Freidel (98) got a cure in 29 out of 39 patients by the use of only three injections.

Other forms of suggestive therapy include urethral sounding, spinal tap, and miscellaneous forms of irritation.

MEDICINAL: It has been said by Davidson that drugs do not cure enuresis but may aid in speeding up the cure. Ruhrah (135) reports that most of the drugs listed in the pharmacopea have at some time or other been used to cure enuresis. He list some 30 drugs which have been given the greatest workout.

Over 80% of the bibliography listed mention atropine or one of its derivatives as the most useful drug in the therapy of enuretic children. It is recommended by all these writers in amounts which cause flushing of the face. It is administered at 4:00 p.m. and at bedtime. It is agreed that the action is to allay vesicle irritability. It is of interest to note that when atropine is prescribed it is always in addition to the routine measures which have been previously outlined.

Wile and Orgel (133) undertook to treat a series of 100 enuretic children, 50 without any drugs and 50 with atropine.

Following are the results:

	<u>With atropine</u>	<u>Without drugs</u>
Cured	17 or 34%	19 or 38%
Improved	22 or 44%	17 or 34%
No effect	11 or 22%	14 or 28%

Fordyce (37) reports 5 out of 19 cases cured with atropine, or about 25 %. Davidson cures 36% of his patients without drugs and gets an additional 15% cure when he uses atropine.

Wile & Orgel (133) proved in their experiment that atropine has little or no effect on enuresis. They quote Hare who has done much work on the pharmacology of atropine: "Belladonna is a cerebral excitant, a depressant to motor nerves, a sedative to sensory nerve endings, and an antispasmodic to smooth muscle. Atropine does not act on striated muscle. As atropine is eliminated by the kidneys there is a local action on the nerve endings in the bladder. It is eliminated very rapidly from the stomach and excreted into the urine. The concentration in the urine is so slight that there is hardly any physiological action on the sensory endings in the bladder." Bastedo states that the action therapeutically is only for an hour or so at the most, and in the small doses usually given, atropine or belladonna is positively ineffective on motor or sensory functions. It is an emergency drug and to get physiologic effects large doses are needed and in addition get disagreeable symptoms.

Thyroid extract therapy is strongly recommended for children who in addition show some symptoms of hypothyroidism. Williams (79) is the greatest advocate of this therapy and recommends from grains $\frac{1}{2}$ to grains $2\frac{1}{2}$ t. i. d. as the necessary amount. He states that this medication need be continued for only a short time before the enuresis clears up. Fleischner (97) reports cures in 8 out of 10 patients by the use of grains $\frac{1}{2}$ t. i. d. Firth (99) in 28 unselected cases, treated routinely so, reports 16 cures.

Mc Clintic (53) gives an excellent explanation of the probable action of thyroid extract when he says: "If the endocrinologists are correct when they tell us that thyroid is antagonistic to the adrenals, then we know that adrenalin stimulates the sympathetic system in such a way as to relax the involuntary muscles. So in hypothyroidism, the secretions of the unopposed adrenals would relax the involuntary sphincters and produce enuresis. Thyroid extract would act in stimulating them to close. This accounts for cases of cure reported from giving thyroid extract." In addition, thyroid shows a general improvement in slow, mentally retarded patients.

Another drug which has been given much credit in controlling enuresis, and about which much has been written, is the extract of the posterior pituitary. Palmer writing in Nelson's Loose Leaf Medicine sums up all the work which has been done on the pharmacology of the posterior pituitary extract as follows: "Watery extracts when injected subcutaneously or by vein, produce an antidiuretic effect in normal animals which have been given large amounts of water and would without the gland extract, excrete the fluid within two to three hours after administration. A single injection delays the diuresis for from seven to twelve hours." Bastedo says that it causes an increase in tissue swelling and ability to hold water, and that the injection is usually followed by polyuria. It is agreed by all men that this substance is the only one which is capable of controlling the symptoms of diabetes insipidus.

Blau (10) reports cures in 75% of his cases with the use of posterior pituitary extract; Bonacarsi (11) cured eight

out of his twelve cases and reports that the other four were greatly benefited. Mc Clintic advises that if enuresis is due to decrease in irritability or hypotonicity of the musculature of the bladder, then pituitrin is the drug of choice. But he does not say how one diagnoses such an etiological factor. Moss (57) reported cures in half of his fifty cases by giving three grains daily for two weeks, and improvement in the other half of his cases. Jacobs (106) treated 49 cases with from three to nine injections of one c. c. weekly, and reported complete cures in 16, much improvement in 17 and no effect in the remaining 16.

Strychnine is a popular drug for this condition in the hands of some men. Adler says it is the drug of choice for weakness of the sphincter; Pisek holds the same view and in addition says that the tonic effect of strychnine to the body is helpful. He recommends a dose of grains 1/60 t. i. d.; also mentions the use of elixir I. Q. S.

For the neuropathic child, Carter (26) and Pototzky (67) recommend Camphor monobromate at bedtime or twice daily in doses of 0.1 gram with Calcium lactate 2 grams. They say that this regulates the circulation and is a sedative to bladder contractions.

Smellie (37) working on Barrington's conclusions (see under the section on physiology), decided that the drug needed will be one which will affect the motor myoneural functions with, in addition if possible, the unstriped muscle direct, but leave unaffected the inhibitory functions. Ergot would appear to satisfy these demands as its action is mainly due to the two alkaloids, ergotoxine and ergamine. Ergotoxine

in small doses stimulates the motor myoneural functions but has no effect on the inhibitory functions, while ergamine acts directly on the unstriated muscle cells. To a child of 4 or 5 he gives the following:

Rx.	Liquid extract ergot	Min. 5
	Extract licorice	Min. 5
	Peppermint water q.s.	Drams 1

T. i. d. for a week and if get no results to increase dose slightly.

He also gives larger doses to older children. After treating 13 cases with this preparation for six weeks he got five complete cures and so much improvement in the rest that they discontinued coming to the clinic.

Any symptomatic drug therapy which is indicated should be used also.

MECHANICAL AND SURGICAL: Adler reports cases where the meatus was sealed over with collodion at bedtime; the pressure of the urine awakens the child and thus is gradually weaned from bed-wetting. In cases where there is a relaxation of the urethra and loss of tone he reports the injection of paraffin along the urethra.

Weitzell (80) quotes Freud, who, working on Head's theory of reflex sympathy between internal organs and those skin zones which derive their sensory nerves from the same segment of the spinal cord, believed that a continued hyperemia on these zones would affect the internal organ. So he used ethyl chloride on Head's skin zones corresponding to the bladder on 23 cases. The bladder is innervated by the 2nd to 4 th sacral segments so he applied cold over the sacrum and in a few places just above the symphysis over an area as large as the palm of the

hand. One or two applications at intervals of three or four days were enough to effect a cure.

Emerson (35) has injected saline solution subcutaneously in the perineum with favorable results. Meatal dilatation in the hands of some men has proved successful; also bladder massage through the abdomen, rectum or vagina.

Melleo-Leitao (110) describes a very clever electrical gadget which works wholly by suggestion. Two metal plates separated by a piece of absorbent cotton are placed in the bed beneath the patient's pelvis. The plates are connected by wires to one pole of a battery and bell hook-up. When the child urinates, the circuit is completed by the wet cotton and the bell rings, awakening the child. In a few nights he is cured. Johnson (104 & 105) has written a long article about the various electrical gadgets which have been used at one time or another.

Among the surgical treatments which have been used to cure enuresis the list begins with an operation for tonsils and adenoids to circumcision of the penis or clitoris. The literature is well agreed on the fact that the correction of these two common conditions even where they are indicated are in themselves not conducive to a cure unless the other measures are also adopted. A reference to Campbell's work where there has been demonstrable neuropathy present in some of his enuretics will reveal that almost everyone of the urological surgical procedures have been done.

Freeman (96) popularized the epidural injections of saline solutions in the sacral hiatus. He says that the nerve roots of the cauda equina are stimulated and you get an inhibition of

the sphincter. He ran controls with merely sticking the children and reports cures of 80 % of his cases where he injected the solution. Melleo-Leitao (110) cured 5 of 7 very obstinate cases with the injection of artificial serum in the sacral canal. Emerson (35) treated 13 cases by the withdrawal of 10 cc. spinal fluid and the injection of 10 cc. normal saline with complete cures in eleven. In the two who were not affected one had a dry tap and the other only had 6 cc. of saline put back after the 10cc. was drawn off.

Change of environment acts almost miraculously in some children; boarding schools, hospital wards, vacations in the country at children's camps are those most often used.

SUMMARY AND CONCLUSIONS

Following is a list of conclusions which can readily be arrived at from the material presented in this paper:

1. Enuresis is a very common complaint in childhood, far more common than is supposed by most physicians in general practice.

2. The etiological factor which is present in over 75% of the cases is improper training during infancy and the persistence of a normal infantile habit into early childhood.

3. A great majority of these children have numerous other neurotic traits in addition to enuresis such as nailbiting, outbursts of temperament, tantrums, feelings of inferiority, and sensitiveness to various emotional stimulations.

4. Physical factors are insignificant in any but a small group of cases, but mostly exert their influence indirectly through erroneous assumptions by parents and others as to being the causative factor.

5. Emotional factors constitute by far the largest group of elements in the continuance of enuresis.

6. Circumcision, masturbation, race, sex, intelligence quotient, time of dentition, etc. are not factors in causation of enuresis.

7. The treatment is mainly that of habit training and mental therapy. The various methods of instituting suggestive therapy have been presented. In addition the child should be treated for any associated conditions, giving careful care to genital irritation.

8. If the statistics presented by various authors as to the success of one or another form of therapy will be carefully examined it will be found that the percentage of complete cures, improvements and failures to have any effect, are practically the same:

- a. Forty percent of the cases are cured merely by some limitation of fluids and one waking period.
- b. Another forty percent can be cured or greatly improved by the use of some form of suggestive therapy, whether it be psychiatric, medicinal, hypodermic injections or mechanical devices.
- c. The remaining twenty percent do not respond to any kind of therapy, but many of these clear up at the time of puberty.

December 5, 1934.

A colored boy aged 2yrs. 8 mos. was referred from the pediatrics department to the behavior clinic because of enuresis. At the age of two he had established control of his bowels and urinary mechanism. Six months later he began to wet the bed nightly. He had a frequency during the day also, but urinary examination on several occasions were all negative. Atropine had been prescribed by the pediatric department along with routine measures, which the mother did not heed very religiously because of six other children needing some of her attention.

No situational disturbance could be obtained to account for the sudden onset of enuresis six months after his habit had once been controlled. Physical examination revealed nothing of note. He had no other behaviour traits which would place him in the unstable nervous system classification.

The boy was put on the enuretic regime and the mother told to follow out the instructions to a letter. He was given one waking period and a calendar with gold stars. The child showed much interest in the gold stars; atropine dose cut to 2 drops.

December 12, 1934

Child brought in calendar with three gold stars on it. The medication was discontinued and the mother was told that this was a normal response and that the child was doing well.

December 19, 1934

The child came in with four gold stars on his calendar.

December 25, 1934

The child was seen at home acutely ill, pneumonia was diagnosed and the child was taken to the County Hospital where he remained for two weeks, acutely ill and very toxic. While here

he was enuretic nightly.

The child was next seen on February 6, 1935 and was found to have been enuretic nightly on his return from the hospital. He was given a new calendar with gold stars and mother instructed to continue the enuretic regime as outlined. The child beamed when he saw the stars.

February 13, 1935

Child came in with seven gold stars on his calendar. The mother had already quit waking him for the past two days also. The mother was told to quit the waking periods entirely.

February 28, 1935

The child had had two wet nights in the past two weeks, told to return in two weeks.

March 14, 1935

The child has not been enuretic for the past two weeks, so he was dismissed as a probable cure. He will be checked in one month.

CASE NO. 65372

A colored girl, aged 7½ yrs. entered the clinic on December 5, 1934, with enuresis as the only complaint. This had been present since infancy. She wet the bed from 5 to 7 nights weekly. She had been shamed by her mother in front of the other children. The mother had tried an occasional waking period and had made some attempt at limiting fluids. The child was of the sensitive type and was very unstable emotionally, becoming easily distempered and going into tantrums. The physical and urinary examinations were negative. She made grades of all "A" in school. She was put on the enuretic regime with a 10:30 waking period and a calendar with gold stars.

Dec. 12, 1934 Had 3 gold stars on calendar.

Dec. 19, 1934 Had 6 gold stars on calendar for the last week.

Feb. 6, 1935 Child came in in response to letter sent out.

Mother said that the child was doing so well that she did not see any reason for bringing her to the clinic.

She had only two wet nights in the past six weeks.

March 14, 1935 On a follow up visit it was found that the child had been enuretic only once during the past five weeks, so the case was dismissed as a probable cure.

Case No. 60405 Age 12. This boy has wet the bed nightly since infancy, averaging from five to seven nights weekly. His father wet the bed nightly until he was fifteen years old. The boy had been put on irregular fluid restrictions and has been waked at different hours of the night to urinate without any change in his habit. His mother has spanked him at various periods without any effect. The rest of the family showed much concern over this habit and used to remind ^{him} of it at various times. The boy appears to be very stable emotionally and has no other disturbances of behaviour. The patient presented certain features of hypothyroidism, namely; coarse dry hair and skin, short stubby fingers, small stature for his age, and a dry cold skin. He was X-rayed for bone growth which was found to be normal in all respects. This boy had a frequency of from 8 to 12 times daily, and his output was found to be anywhere from one ounce to twelve ounces at one urination. With the following findings he was put on the regular enuretic regime with one waking period at 10:30 p.m. He was told to keep a record of the dry nights only and to urinate less frequently during the day time.

March 14, 1935. Patient came in with a record of four dry nights for past week.

March 21. Had five dry nights.

March 28, Had five dry nights; mother forgot to wake the patient on the other two nights. Elixir I. Q. S. was given to "speed up the cure."

April 4. Had six dry nights for past week, mother forgot to wake the boy on one occasion.

April 11. Patient came in with a record of seven dry nights last week. The mother had been told to leave the child sleep through on the first two days of last week, and if he was dry to allow him to go on so for the rest of the week. The mother had not awakened him once last week. The waking periods were therefore discontinued and the boy told to come in again in one week for a check up.

Case No. 65089. This boy, aged 16, was referred to the behavior clinic because of enuresis, which had been continuous since infancy with occasional, rare dry nights. He was enuretic five nights out of every week. He had never been treated by anyone for his condition, was chided by his older brothers and sisters and was scolded by his mother. There is a long social history on file about the family which shows many psychopathic traits in the family. The boy contracted a G. C. urethritis from a married woman in the neighborhood and was treated by the Urology department which referred him to our clinic after curing him of the ~~re~~ urethritis. The boy had been filled with some very foolish fears about what would happen to masturbators and was very much concerned about this. He had various other problems which were troubling him also.

This boy was seen for the first time on January 26, 1935 and an hour was spent talking over his difficulties with him. He enjoyed very much having someone to talk to who would take an interest in his problem. He was told about the routine procedures to carry out, and the family was contacted and told not to take any interest in his condition and to try and help

him in any difficulties which he had. He was given an Rx. of Elixir I. Q. S. as a placebo and told that this would help him get rid of his trouble.

He was seen again on Feb. 4 and was found to have had five dry nights out of the past ten. Various problems were gone over and school was discussed.

The next visit was on Feb. 14, when the boy reported seven dry nights in the past 10 days. The boy was reassured that he was coming along fine and to continue on the regime.

Seen again on the 21st. , five dry nights were reported for the past week. He came in again on the 28th and reported six dry nights. The patient had spring vacation next week and was told to come in again when vacation was over.

He was seen again on March 28. The boy came into the clinic in very high spirits, and was very enthused over the fact that he had been free from bedwetting for the past month. He said that he was completely cured and was very glad. We told him to come in and see us again whenever he had any thing which was troubling him and we would ~~try~~ try and straighten them out.

Case No. 42712 This patient, aged 8 years, was referred to the clinic because of an inability to read. He was in the first grade in school and was kicked out because of his cruelty to the other children and his misbehaviour. In addition he was enuretic nightly. He was living in a rooming house with an aunt. He was seen for the first time on November 9, 1934. After one months special reading instruction from a specially trained teacher, and transfer to a nice boarding home, the boy's entire dis-

position changed; he was readmitted to school again as a good pupil and his enuresis cleared up without any special measures directed towards this problem.

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