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ROYAL SOCIETY OF MEDICINE—SECTION OF LARYNGOLOGY

March 2nd, 1945

President—C. GILL-CAREY, F.R.S.C.Ed.

Discussion on an Upper Respiratory Clinic for Children

The Willesden General Hospital, London

F. C. W. CAPPS

THE routine examination of children with nasopharyngeal symptoms is apt to become a matter of habit in clinics strictly confined to their own particular field.

To deal with this, a team seemed to be indicated: (*a*) To interpret history and symptoms in terms medical and social; (*b*) to encourage repeated attendances in order to avoid a hurried decision at a single consultation, to record progress, and to maintain the physiological response to environmental infection free of symptoms; (*c*) to investigate the devolution of the mouth-breather and to combine the resources of the speech therapist, rhinologist and orthodontist, to reverse the process; (*d*) to deal with nasal and bronchial catarrh as a single pathological entity with the nasal cavities and accessory sinuses as the upper, and the bronchial system as the lower bacterial barrier: (*e*) to employ routine radiography of the sinuses with the object of early recognition and clearance of occluded areas and soft tissue radiography to show the presence of a pad of adenoids; (*f*) to recognize and remove tonsils that are subject to recurrent bacterial invasion and inflammatory reaction, particularly where morbid changes may have taken place which threaten the lymphoid barrier.

In the child it should be possible to correct disturbances before an established pathological state supervenes. It is not easy to keep this viewpoint when one is seeing children in a general clinic. An E.N.T. Clinic for children only was therefore started.

The team at present consists of a social worker, rhinologist, speech therapist and orthodontist. Children are seen by members in this order, but not necessarily on the same day. We should also have a pædiatrician and he may be the controlling member.

The persistent mouth-breather has been our especial concern. The association of a rhinologist and orthodontist to investigate this condition is not new, for Warwick James and Somerville Hastings read a paper on "Mouth

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Breathing and Nasal Obstruction" to the Section of Odontology in 1932. (*Proceedings*, 25, 1343).

During childhood the sinuses are not fully developed, and the pharyngeal lymphoid tissue undergoes physiological hypertrophy.

It is of interest to note that at puberty when the sinuses reach a stage of development comparable with that of the adult, the phase of lymphoid hyperplasia is replaced by a process of atrophy; if the tonsils and adenoids are removed at an age when the sinuses are immature, a generalized hyperplasia of the pharyngeal lymphoid tissue may follow.

Routine serial radiography has proved to be essential in the correct interpretation of symptoms referable to the upper respiratory tract. Thickened or œdematous mucosal linings (56% in summer and 65% in winter over a series of 360 cases recorded in 1942-43) were rarely followed by infected antra. Surgical treatment was not indicated.

The high incidence and transient nature of sinus opacities suggest that the lining mucosa shares in the defensive reactions of the upper respiratory tract, but the precise relationship with the inflammatory reactions of the lymphoid tissue is uncertain.

Our aim in treatment throughout should be to temporize until stability is reached.

Lack of aeration and occluded ostia are the precursors of impaired ciliary drainage and retention of secretions. Proof puncture and aspiration, followed by repeat puncture and irrigation or ephedrine displacement, is employed in selected cases and progress controlled by serial radiography.

Exclusion of an established upper respiratory infection is essential before interference with the lymphoid barrier is contemplated.

In discussion of the tonsil problem here in 1940 (*Proceedings*, 33, 347), repeated attacks of inflammation received priority and were held by some to be the only indication for operation. The observation of Kershaw at that discussion is worth repeating—" that operation during the stage of physiological response to environment is contra-indicated ".

An investigation made in 1931 suggests that a deficiency in the diet of fat-soluble vitamins is one of the factors, though not predominant, which tends to produce an overgrowth of adenoid tissue. Increased knowledge of causation and prevention can only come from a more thorough medico-social investigation of the first three or four post natal years and maternal history during pregnancy.

In 1943 there were 557 new cases and attendances for progress numbered 2,400. Tonsils and adenoids were removed from 216, that is 48%. For 1944 the new cases were 440, attendances for progress 2,200, operation for tonsils and adenoids 158, or 36%.

We do not advocate that the clinic be copied until it can be shown to produce results superior to those already attained by the older methods of isolated consultant clinics.

E. GWYNNE-EVANS

The mouth-breather problem.—The respiratory function requires the co-ordination of many muscles. Co-ordinated movement is an interplay between

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SOFT TISSUE PROFILE RADIOGRAPHS. (MOUTH OPEN.)

The habitual co-ordination of the palato-lingual musculature free of conscious control. 1. In the presence. 2. In the absence of adequate levels of tone and neuro-muscular activity.

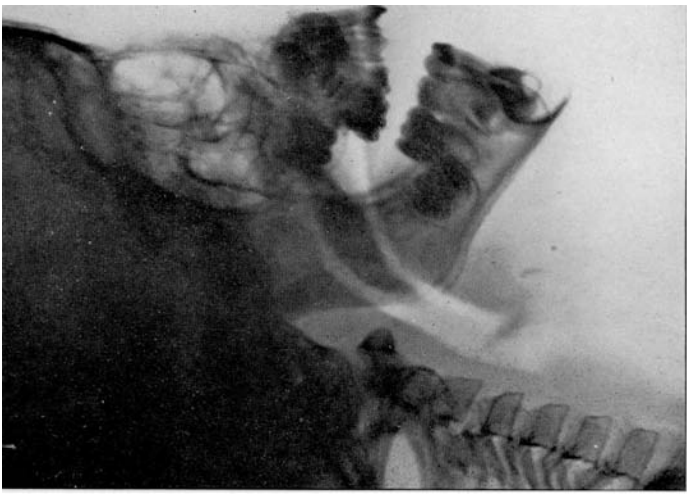


Fig. 2.
Failure of the palato-lingual reflex to close the faucial isthmus results in mouth-breathing.



Fig. 1.
An active palato-lingual reflex closes the faucial isthmus and preserves nasal breathing.

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reciprocal muscles in alternating contraction and relaxation—two opposite physiological actions of muscle activity.

Although there can be no absolute state of muscle rest owing to tonus, the position of physiological rest corresponds to the normal position of equilibrium between antagonists.

A colour film was made demonstrating the reciprocal co-ordination of the tongue with the palatal velum in closure of the faucial isthmus.

These observations were supported by a large number of soft tissue radiographs of the palato-lingual musculature at physiological rest.

Serial radiographs have demonstrated the stability of the palato-lingual patterns, when care has been taken to ensure that the musculature has assumed the habitual position of rest before exposure is made.

The radiological pattern depends on the degree of tone and the habitual co-ordination of the musculature. Normally, if the mouth is open, the shadow

TRACING OF A SOFT TISSUE PROFILE RADIOGRAPH.
(PARTLY DIAGRAMMATIC.)

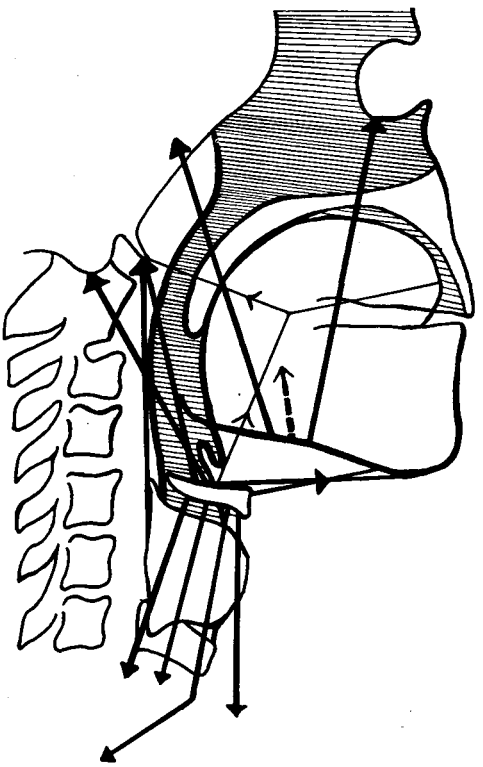


FIG. 3.
The holding muscles of the skeletal framework in relation to the airway.
Reciprocal opponents in a state of balanced equilibrium, i.e. the position of physiological rest.

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of the palatal velum is contracted round the base of the tongue, which is elevated and retracted to close the palato-lingual space.

When the musculature is unduly relaxed, the jaws are open, but the arching of the tongue is inadequate, and the palatal velum occupies a midway position between the post-nasal and palato-lingual spaces.

In the presence of an obstructive pad of adenoids, the jaws are usually open, and the co-ordination of the musculature is disturbed. The adenoid shadow may obliterate the post-nasal space, the posterior mass of the tongue is depressed away from the palatal velum, whilst the tip of the tongue may impinge against the pre-maxilla.

These are two distinct patterns of the established mouth-breather; the pattern of the intermittent mouth-breather may be indeterminate.

Negus has shown that keen-scented mammals are provided with an elongated palate which is in contact with an efficient epiglottis to preserve the olfactory sense with the mouth open. He has pointed out that with " . . . the recession of the jaws and the flexion of the head on the vertebral column; the larynx has descended in the neck, being forced to do so by the tongue, which assumes an arched shape. The result is the separation of larynx from nasopharynx with a wide gap between epiglottis and soft palate . . .". We have repeatedly observed that an open mouth is not necessarily indicative of mouth-breathing but the palatal velum forms a tense low arch meeting the posterior mass of the tongue which is instinctively drawn upwards and backwards to close off the oral cavity from the airway.

Whilst we partly agree with Somerville Hastings and Warwick James that the reciprocal co-ordination of the tongue with the palatal velum constitutes a posterior oral sphincter, we suggest that the palato-lingual mechanism is basically a postural reflex, comparable to the reflex action of the glottis, and is a valve which is closed to preserve the function of nasal respiration if the mouth is open.

The reflex rhythm of the lower respiratory musculature is modified by the development of the cortex, but remains essentially automatic, and is less vulnerable than the evolutionary younger upper respiratory musculature which comes largely under the influence of cortical control. As the child learns to master his muscle activities they become a reflex practice, and the higher level control is replaced by a lower level mechanism with the development of muscle sense. Until the stage of stability is reached, the facial, lingual and palatal musculature is particularly prone to disturbances of co-ordination.

The most serious cause of muscle disturbance is loss of tone. Although any number of factors may produce the picture of the hypotonic child, tonus is basically a neurogenic property of muscle activity in which both higher and lower centres are concerned. The role of the higher centres is uncertain, but the frequent association of a dull mental attitude as a primary rather than a secondary factor should not be overlooked.

In the opinion of Sir Arthur Keith and G. G. Campion, the" narrow deeply arched palate, the so-called ' adenoid facies ', is not a single defect in an otherwise well-developed face, but part of the failure in the general growth of the face ".

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We suggest that persistent mouth-breathing also, is not necessarily a single defect secondary to post-nasal obstruction in an otherwise healthy child, but may be part of the general failure in the proper development of neuromuscular activity. When combined with a dull mental attitude, habitual mouth-breathing might then be characterized as a true functional disorder.

An attempt has been made to analyse disturbances in terms of functional "disolution", an expression used by Hughlings Jackson as meaning the "reverse of evolution"; it is a method of approach that has already been adapted to speech pathology by Leopold Stein.

The preponderant holding muscles of the mandible are the masseter and temporalis. The mechanism in closure of the jaws is stronger than the mechanism of opening, so that when the musculature is normally relaxed, the mandible assumes a balanced position in light occlusion with the maxilla, known as the resting bite.

Failure of muscles follows a devolutionary sequence, affecting some, but nor necessarily all, of their functions. Undue relaxation of the musculature allows the mandible to be released at any age; in older children, flaccid muscles of facial expression and certain speech defects including some deviations of nasality indicative of palatal disturbances are among the earlier signs. Mouth-breathing supervenes when the framework of the palato-lingual pattern is also relaxed, with a diminished or absent reflex to effect closure of the faucial isthmus when the mouth is open.

Stagnation of nasopharyngeal secretions may result from the added failure of the palato-pharyngeal musculature, to effect proper drainage of the post-natal space.

Functional weakness is distinct from an organic paresis that would result in regurgitation of fluids through the nose. Negus points out that the swallowing movement commences in the highest part of the nasopharynx with the " . . . . raising of the soft palate and closure of the nasopharyngeal isthmus by approximation of all its walls; initial closure is followed by a wave of constriction effected by the superior constrictor muscles with the object of squeezing out mucus, debris and bacteria dumped by the ciliary streams of the nose and sinuses to be carried downwards through the pharynx into the œsophagus and stomach". When secretions are allowed to remain in contact with the pharyngeal wall for any length of time a subsequent lack of sensitivity to initiate the swallowing reflex increases the liability for nasopharyngeal infection to follow the alternative physiological route into the tracheo-bronchial system.

Enlarged tonsils or adenoids interfere more directly with velar action and the drainage mechanism. On the other hand, the constant repetition of oral breathing as the result of an inability to overcome persistent post-nasal obstruction will produce a wrong habitual co-ordination of the palato-lingual musculature which may or may not continue after the cause of the obstruction has been removed.

The Orthodontist has related failure of the orbicularis oris and alae nasi in some cases to a state of imbalance among the facial muscles associated with a malrelationship between the jaws.

Methods of investigation.—Children are examined jointly by the rhinologist, speech therapist and orthodontist. The upper and lower respiratory mechanisms

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are grouped together as reciprocal antagonists and considered in terms of neuromuscular activity under the growing influence of cortical control. Clinical estimation of function is supported by radiography. A profile radiograph of the palato-lingual musculature is exposed in the habitual position of rest during quiet respiration, and the costodiaphragmatic rhythm is observed under the fluorescent screen. While it is usual to relate the respiratory musculature to the postural balance of the body segments, the Orthodontist has taken a new departure by relating the upper respiratory musculature to the craniomandibular and cervical segments.

Management of cases.—Early recognition and clearance of occluded airways is an essential requirement whilst tonsils or adenoids that interfere with velar action are removed. It has become increasingly evident, however, that management of the habitual mouth-breather implies not only re-education of the anterior oral musculature, but the cultivation of tonus and reflex neuromuscular activity in the posterior groups of muscles that are responsible for ventilation and drainage of the nasal spaces.

Anterior oral musculature.—The plan of rehabilitation is considered from the myogenic aspect that " the position of rest is the physiological basis for re-education of muscle function " (Colin Mackenzie) and from the neurogenic aspect, by bringing muscle action into the conscious plane through games, exercises and devices that are designed to cultivate tonus, and by blazing a pathway through the synapses, encourage reflex muscle activity free of conscious effort, until correct habits of co-ordination are finally formed.

The Orthodontist's observations on the developmental pattern of the jaws in relation to the behaviour of the facial musculature and nasal respiration led us to adopt his method of using a modified Andresen appliance as an intra-oral splint to obtain an optimum relationship between the jaws and a state of balanced equilibrium between the muscles.

Re-education is begun as the orbicularis oris and attendant muscles of facial expression are actively moulded round the renewed basic support, and the previous unconscious behaviour patterns are upset.

Reflex tonus of the musculature is cultivated through the conscious effort necessary to hold the appliance in place at intervals during the day. Later, the splint may be retained without further thought or attention as a habit, and can be worn mostly at night.

Re-training of the anterior groups of oral muscles in correct habits of co-ordination involves neuromuscular pathways that are inter-related with the development of speech, and it may be desirable to pass cases through the hands of the speech therapists for special exercises before adequate kinæsthetic control is regained. An inability to combine the association of muscles at the necessary speed required for speech may call for a prolonged course of speech therapy.

Posterior oral musculature.—We regard the palato-lingual and palato-pharyngeal mechanisms as reciprocal antagonists that are not entirely under direct control, but are largely ruled through lower levels of the nervous system. The cultivation of tonus and reflex neuromuscular activity in the posterior groups of muscles are therefore not so dependent on bringing muscle action into the conscious plane. The Orthodontist has observed that recurrent

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Fig. 1.

The low level of the hyoid related to relaxation of the lingual musculature.



Fig. 2.

Same case after 10 months' treatment. Increased tonus of the musculature. Note relative positions of hyoid bone.

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acts of swallowing are induced by the presence of the appliance in the oral cavity and they probably play a large part in " reconditioning " the posterior oral reflexes.

Comments.—There are indications that recovery of function follows the evolutionary sequence. Radiological evidence of palato-lingual closure has been persistently obtained, but tonicity of the facial muscles and the reflex closure of the orbicularis oris free of conscious effort have been more difficult to achieve.

Where post-nasal obstruction has led to a wrong co-ordination of the musculature and large tonsils have interfered with velar action, palato-lingual closure has also been obtained following operation in some, but not all cases.

General considerations.—Failure to maintain proper extension of the vertebral column plays an important part in the respiratory disturbances of the mouth-breather. Exercises and games which draw the child's attention to those groups of muscles that are involved in the general extensor reflex are combined with methods that encourage correct reflex habits of breathing.

A pædiatrician is to be appointed to assess environmental, nutritional and metabolic factors that contribute towards hypotonus. The advice of a child psychologist is also required to determine intelligence levels and psycho-emotional factors before we are justified in suggesting that persistent mouth-breathing in the presence of a dull mental attitude may be a true functional disorder.

We have yet to judge the practical value of these methods of approach before they can be accepted as part of the routine procedure in the E.N.T. Department.

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ARNOLD A. NOVE

I have observed that children with malrelated jaws and malposed teeth have not only facial asymmetry but tend to develop a stooping posture and winged scapulae. These are associated with post-nasal catarrh and other respiratory symptoms.

Close analysis will reveal this as a state of imbalance between intrinsic and extrinsic musculature of the head and neck.

Small dental arches and short or obtuse ascending rami prevent the tongue from occupying its proper position in the oral cavity. Instead of lying horizontally with its tip touching the lingual surfaces of the anterior teeth, the tip of the tongue abuts against the palate (behind the pre-maxilla). This causes the tongue and hyoid to sag, involving other closely related anatomical structural units connected with deglutition and respiration. This muscular imbalance, with consequent sagging of the tongue, is associated with facial disharmony as well as postural defects (*see* figs. 1 and 2).

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Thus, the most important clinical factor connected with the syndrome described in the opening paragraph is the position of the tongue in the oral cavity.

In the normal individual the integration of the structural units connected with mastication, deglutition and respiration produces a state of equilibrium—with the mandible and hyoid bone as a combined pivot or fulcrum.

In action a gentle synergic wave of contraction includes the temporal, the masseter, orbicularis oris and hyoid group, ending in a quick, uninterrupted, effortless act of deglutition, followed by relaxation. When the jaws are wrongly apposed medially, anteroposteriorly or vertically, this indispensable fulcrum is out of true and all the structural units connected with mastication, deglutition and respiration are compelled to act by adaptation.

Under favourable or normal conditions we have a distinct pattern of deglutition behaviour easily observed clinically, just as a normal gait has a definite pattern or character. Therefore only a correct anatomical relationship of the units concerned will permit free or physiological function of mastication and deglutition.

To correct faults the bony framework must be so reconstituted that the bimaxillary space provides ample room for the physiological requirements of the tongue, thus correctly positioning the larynx with the nasopharyngeal space.

The achievement of this ideal integration of structural units is an orthopædic problem of some complexity and I would define this new approach as " cervico-facial orthopædics ".

After the jaws have been orientated in accordance with the above physiological requirements an improved Andresen type of splint is used for intermittent wear (mostly at night). Such craniomandibular intermittent immobilization with the corrected orientation allows the musculature to develop and the osseous structures to maintain their corrected position. The jaws being apposed by the splint are provided with the necessary fulcrum for the musculature during each act of swallowing and keep the airway in normal function from the moment the splint is worn. Fortunately, muscles being very readily trained, the splint provides the necessary stimulus for remoulding of the skeletal framework in response to the newly imposed muscular stresses, in accordance with the well-known principles of bony reconstruction as propounded by John Hunter, Wolf and others—frequently alluded to as " Wolf's law ".

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JOAN H. VAN THAL

The aim is to restore function by getting the patient to perform actions already within his scope, based on innate patterns, though these patterns may be dormant. Fatigue and boredom must be avoided, and unnecessary effort or inappropriate responses eliminated.

For the young patient the approach is largely through games that give him the mental picture on which to base his respiratory behaviour; activity starts from relaxation and is not superimposed on musculature that is already fatigued. The games and exercises bring respiration into the conscious plane, i.e. under cortical control; thus correction and adjustment can be achieved, until a habit is formed, or, in other words, a conditioned reflex established.

In some cases inhalational therapy has been combined with breathing exercises. The patient was either admitted to the ward for two weeks, and three times daily inhaled a 5% carbon dioxide-95% oxygen mixture through a B.L.B. mask for about fifteen minutes, or the child attended as an out-patient once a week and had inhalational therapy prior to breathing exercises.

Observation under the fluorescent screen of the response in the case of G. C. furnished interesting data: Told to take a deep breath the boy moved his shoulders up and down, and diaphragmatic descent was almost nil. While inhaling the mixture of carbon dioxide and oxygen, clavicular breathing was spontaneously replaced by costodiaphragmatic action. Without the mask performing his breathing exercises, the extent and rhythm of the costo-diaphragmatic excursion were maintained in the same degree. This observation demonstrates thay breathing exercises can set up normal respiratory behaviour. Often it is more practical to do such exercises than to inhale carbon dioxide and oxygen in order to stimulate the reflex response.

Unless intelligent co-operation from the mother is assured, breathing exercises are not given to children below the age of 6.

Care is taken to eliminate the common error of raising the cage of the thorax under the illusion that this is tantamount to expanding it. Exercises and games are devised to encourage relaxation, flexibility and rhythm of the costodiaphragmatic musculature rather than attempting to increase capacity.

Attention to posture is maintained throughout. The child may be referred to the physiotherapy department later.

Weekly attendance is advocated for a period of about three months and after that, fortnightly or monthly for another six months, with home practice

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between hospital attendances. Each child attending for respiratory rehabilitation has twenty minutes' individual attention. Children attending for ephedrine displacement are given a few minutes of routine exercises immediately after that treatment has been carried out.

Some of the playful exercises for the facial muscles and upper airway are carried out as follows:

(*a*) Observations of the difference between an open and a closed mouth: (1) By visual means; (2) by noting the different sensation when the lips are parted and when they are in contact. *For example*, the child pretends to be a fish, swimming about opening and shutting its mouth.

(*b*) Maintaining closure of the lips. *For example*, the patient sits in front of a mirror mainly occupied by listening to a story or something else that holds his interest, and at the same time is watched to see if his lips remain shut. This alternative occupation avoids stress.

(*c*) Intermittent clearance of the upper airway. Encouraging use of the upper airway. (1) The child pretends to smell flowers or to be a dog sniffing at its dinner; (2) a game of blowing at some object such as a feather through the nose to hit a target; (3) using nasal resonance, i.e. humming.

THE CHAIRMAN (BRIGADIER MYLES FORMBY) said that the great importance of team work in a problem of this nature had been shown. It had been emphasized how wrong it was to anticipate that by dealing with one aspect only of a problem such as this, successful results would be obtained in anything but a very small percentage of cases. He had in mind particularly the removal of the tonsils and adenoids to remedy such conditions as mouth-breathing. Many must have felt bitter disappointment on finding that the child after operation went on as before, with his faulty breathing.

E. MUSGRAVE WOODMAN, after thanking the openers for this broad and interesting survey of the problem, asked for further practical details about the interdental splint. How long was it worn during the day? Was it taken out for meals? On how many occasions had it to be retrieved from the œsophagus? It would be interesting to learn from their dental colleagues how they overcome the difficulty of the long central incisors which frequently projected over the lip and prevented the lips from coming together. One was accustomed to dental splints for restraining the line of the teeth. Did the interdental splint take the place of the metal retention apparatus wholly or in part?

C. P. WILSON said that the opener's demonstration had been a revelation, and if he made any criticism he hoped it would not be considered out of place. He was sorry that no mention was made of the type of patient with what he might call the short upper lip. They had heard nothing at all about the importance of the use of the lips as a factor in moulding the shape of the jaws and mouth in addition to the splinting apparatus.

He understood Miss Van Thal to say that it was not practicable to do anything in the way of breathing exercises with children under 6. With this he disagreed. Miss Van Thal had also said that it was important that the child should not observe if it was opening its lips during breathing exercises. His own feeling was that the most important thing was that the child should

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close its lips unconsciously, not consciously, and there was a simple way of making the child do that, namely by the holding of something in the lips. His own practice had been to make children do breathing exercises for five minutes night and morning. This consisted of holding a light wooden spatula between the lips and while doing so they did active movements, either exercises or playing a game. By doing so they developed the power of breathing deeply through the nose and at the same time holding their lips tightly closed unconsciously, because if they were going to hold a stick in their lips they were not thinking in terms of closing the mouth, but merely of holding the stick, and thus they developed the habit of breathing deeply with unconscious closing of the lips.

DR. L. STEIN said that the approach which Mr. Gwynne-Evans had outlined was a method of approach which he had used for many years in speech therapy. In any case of disturbance it was always the lower level that took over and became dominant. Thus, it was not a loss of function which was encountered but rather a different pattern of function according to what was dominant on that level. Miss Van Thal had referred to the use of such games as pretending to be a fish and so forth. The appeal was to the child's primeval instinct, and by this means the muscle tone was increased, because that was closely associated with the emotional meaning. He did not think that tone could be increased by mere exercises but it could be increased if it was correlated with an emotional attitude.

F. C. W. CAPPS, in reply to Mr. Musgrave Woodman, said that the splints stayed in all night. In the use of hundreds of splints it had never been necessary to retrieve one from the œsophagus. They had to be taken out during meals.

A. A. NOVE, in reply to questions, said that one of two reflexes occurs in the presence of a foreign body in the mouth: one, to eject it, the other to swallow it. During consciousness the desire would be to retain it because of the sense of comfort experienced by the different structural units being correlated correctly. In sleep there was occasionally a tendency during the early stages of wearing the appliance for it to be ejected, but whilst the appliance remained in the mouth, the act of swallowing, which normally took place, caused it to be engaged by the lingual surfaces of the upper and lower teeth as well as by the palate. As its external surface was a negative of the lingual surfaces of the teeth, palate, and mandible it brought about intermittent intermaxillary immobilization. Therefore, while the Andresen splint was easy to eject, it was impossible to swallow. With regard to prominent teeth, reconstruction included the alignment of the teeth. With regard to thumb sucking, in his view it was an indication that the child needed space in the mouth as well as support for the musculature and supplied that need instinctively.

JOAN VAN THAL said that she had not been able to give a full description of all the exercises, but these did include holding some object between the lips, such as a quill, which was a playful substitute for the pipe. The under-sixes learned to blow the nose, also to play the games which encouraged them to keep their mouths shut; it was the actual breathing exercises for thoracic expansion which were omitted in their case.

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ILLUSTRATIVE CASE [*Abridged report*]

R. W., aged 4 years.

History.—Mouth-breathing day and night; snoring and disturbed sleep; recurrent colds; few sore throats. Adenoids removed elsewhere two years ago.

Upper respiratory musculature.—1.6.44: Orbicularis oris and muscles of facial expression relaxed; mandible released; no speech defects other than slight insufficient nasal intonation; inadequate palatal depression, with failure to elevate and retract posterior mass of tongue in closure of the faucial isthmus; tip of tongue abuts against pre-maxilla. Profile radiographs: adenoid shadow insignificant; shadow of palatal velum midway between post-nasal and oral air spaces.

SERIAL RADIOGRAPHS OF PALATO-LINGUAL MUSCULATURE AT PHYSIOLOGICAL REST

1.6.44	Palato-lingual space wide open		
		Without appliance	With appliance
29.6.44	P.L.S.	Wide open	Wide open
13.7.44	P.L.S.	Open	Open
31.8.44	P.L.S.	Open	Just open
21.9.44	P.L.S.	Just open	Just open
26.10.44	P.L.S.	Just open	Closed
2.11.44	P.L.S.	Closed	Closed
Tonsils persistently inflamed—removed			
30.11.44	P.L.S.	Just open	Closed
25.1.45	P.L.S.	Just open	Closed
25.6.45	P.L.S.	Closed	Closed

Present state.—25.6.45: *Posterior oral musculature:* adequate palatal depression, with elevation and retraction of tongue in reflex closure of faucial isthmus.

Anterior oral musculature: orbicularis oris and muscles of facial expression have partly regained their tone; mouth remains closed most of the day. There is a tendency for the mouth to drop open at night. Sleeps quietly with appliance in oral cavity.

Comments.—Mouth-breathing controlled by posterior musculature: habitual closure of orbicularis oris not completely obtained.

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