"A REVIEW OF RECENT ORTHODONTIC THOUGHT"

by Rex E. Fortescue, B.D.S.
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This thesis is a review of recent articles mainly published in the American Journal of Orthodontics, and some published in the Dental Journal of Australia, the Journal of the American Dental Association, and the International Dental Journal, and the recent editions of two textbooks, "A Textbook of Orthodontia", and "Bone and Bones". The material has not been treated in chronological order of publication but according to relevance to the same subject.

An understanding of Orthodontics must be based on a knowledge of the growth and development of the area in which we work, particularly of the jaws.

Growth of the maxillae and of the mandible is by two entirely different processes. Weinman and Sicker (1), and R.H.W. Strang (2) cover this material very well; Strang, however, obtains much of his material from Weinman and Sicker.

According to them, the maxillae increase by sutural growth. This occurs mainly at the Fronto-Maxillary Suture, the Zygomatico-Maxillary Suture, and the Pterygo-Palatine Suture, and secondarily at the Zygomatico-Temporal Suture and the Median-Palatine Suture. The latter suture gives some lateral growth to the maxilla early. It is noted that the other four sutures are parallel and run downwards and backwards, hence growth at these sutures results in a downward and forward movement of the maxillary complex. Some surface apposition takes place mainly to accommodate muscle attachments.
Although the sphenoid bone is an impaired bone, the widening of the maxillae due to their backward divergent growth is allowed for by the divergent growth of the Pterygoid Processes.

The mandible grows by a little growth at the symphysis up till the first year until the symphyseal cartilage ossifies, thence all growth takes place in the hyaline cartilage of the condyles. A little oppositional growth takes place along the border of the mandible but this is rather negligible. As the mandible grows, much remodelling takes place in the rami by opposition of bone along the posterior borders and resorption of bone along the anterior borders resulting in a lengthening of the body of the mandible. The growth taking place in the condyles must be sufficient to lengthen the body of the mandible and increase the rami height. This rami height increase does, or should, accommodate the downward and forward movement of the maxillae as well as the growth of the alveolar processes and eruption of teeth of both jaws. The mandible is also displaced downwards and forwards due to the upward and backward growth of the condyles. Widening of the mandible is due to divergence backward of the body and the widening of the skull base. Weinman and Sicker (1) show that the mandibular angle does not change through life, although the gonial angle as normally measured does change.

There is one point in common in the growth of the jaws in that there is no interstitial growth.

Function according to Weinman and Sicker (1) does affect the surface contour and the trabeculae of bones. A sufficiency or excess of function results in denser bone with thick cortical layer and surface apposition to strengthen muscle attachments, while a lack of
function results in rather spongy bone, thin cortical bone, and in many cases much atrophy and osteoporosis.

Strang (2) also emphatically states that the base bone of the jaws cannot be increased in size by either orthodontic appliances or function, although function does alter bone as stated above.

W.N. Benson (25) states that "Inherited disharmony in the relative rates of growth" is more correct than "inherited abnormality". He says that the mandible has assumed its characteristic form as early as the third month, and the symphyseal fibrocartilage ossifies at one year. The location of the growth increments is important as they result in a downward and forward movement of the jaws, and also in vertical and antero-posterior growth. Condyle head proliferation continues till 20-25 years. The relation of the gum pads at birth is rather controversial, and he also deals with alveolar process growth and tooth eruption; of interest is the downward movement of mandibular canines before commencing eruption. Ramus length growth precedes tooth eruption and alveolar bone growth. Very little change occurs in the gonial angle and what change does occur in old age is purely muscular.

This information was obtained by Benson (25) mainly from cephalometric study, and is of much importance to orthodontics. The sections of his paper dealing with cephalometrics are treated later, but as a whole his paper is a valuable contribution to orthodontic literature.

During mandibular growth, the bicanine dimension according to C.E. Burson (8), does not appreciably increase or decrease.
To quote he says, "That no general rule concerning timing, duration, or amount of increase in mandibular bicanine dimensions may safely be applied to a given individual. (2) That future increases or decreases in this dimension are not easily predictable in attempting to evaluate an orthodontic problem for such an individual in this age range." He also says that the main spurt of growth appeared to be 5 - 8 years of age.

There is not much written on growth and development in the literature, however, the information obtained from Weinman and Sickler (1), Strang (2), Benson (25), and Burson (8) I feel presents a clear picture of growth and development as understood by orthodontists today. The textbook by Weinman and Sickler (1) has been of much help to orthodontists in clarifying and recognising their thoughts in regards to bone, with Strang's (2) textbook emphasizing this. Benson's (25) paper also shows his thoughts along this line, while Burson's (8) paper serves to stress the unchangeability of base bone.

G.T. Millette (5) says that the masticatory function of teeth only developed during the late mammalian era. Original teeth were used for incising and defence. The design of the periodontal fibres in man would indicate that most masticating force is taken by pull on certain periodontal fibres, and not carried to the bone with the periodontal membrane acting as a cushion; this is the true physiology of the periodontal membrane according to Millette (5). He also says that bone has been modified and refined in accordance with form and function. If the load on a bone is increased, or its direction changes, then Wolff's Law operates to
bring about bone change. The pattern and basic size of bone is inherited.

The most important point stated by Milliette (5) is that the periodontal membrane takes the force of mastication by pull on certain fibres and does not act as a cushion between tooth and bone. It is a minor point as far as orthodontics is concerned, but it is rather interesting. There is also some statement of facts already known, but the rest of the paper, while of historical interest, is not, I feel, of use to practical orthodontics.

The practice of orthodontics must include also a knowledge of the reactions of the tissues on which we work.

According to H.E. Lura (3) the absorption and formation of bone is regulated by "a soluble, preformed bone substance.... circulating in the blood in the form of certain calcium-phosphate-citrate-protein fractions of the plasma". Hereditary factors have an overall influence. Osteoblasts and osteoclasts are not pre-existant but differentiate from osteocytes. An increase in the forces of pressure or tension within the limits of tolerance results in apposition of bone, but an increase beyond the limits of tolerance results in necrosis and resorption. Application of tension to a pressure area is impossible, but an application of pressure to a tension area results in resorption. Alveolar bone exists because the function of the teeth maintain it.

Lura's (3) account of biomechanical tissue reactions is of interest in that if such is true then there are possibilities of some degree of artificial regulation of bone growth. The other points mentioned are more or less a reaffirmation of present knowledge.
Whatever an appliance does is only what the periodontal membrane allows that appliance to do, is the opinion of R.E. Moyers and J.L. Bauer (4). A tipping movement is safer and easier to accomplish than bodily movement, as in tipping the unaffected vessels supply blood through anastomoses, but in bodily movement all vessels are affected. Thus in bodily movement necrosis is more extensive and regeneration slower, therefore for this movement a much lighter force is required. Time is necessary to "get teeth used to the appliance" and to "limber up." Instusion, extrusion and rotation should be attempted slowly. Continuous forces should be avoided for intrusion as the membrane is completely compressed and a light continuous force is better for extrusion and rotation movements, as in both these cases the membrane fibres are stretched, so cutting the blood supply. "The speed of clinical response is determined by the amount of periodontal membrane, which must be regenerated before the osseous changes occur." Physiologic tooth movement is non-existent in orthodontics. Light round wires should be used before using an edgewise wire as the latter is a heavy wire causing bodily movement and may result in much necrosis and also root resorption if used early in treatment. The twin wire is the best appliance as it causes less trauma and an earlier response to tipping movements than with other appliances, but even with this appliance caution should be exercised. The ideal appliance would exert a force of 15-25 gms. over a distance of not more than 2 mms. and be intermittent: such appliance does not exist. They feel that failure is due in many cases to a lack of knowledge of the periodontal membrane.
I feel that this article could profitably be read by anyone practising orthodontics. Moyers and Bauer (4) have ably shown the importance of the periodontal membrane in tooth movement; they also show how by using care this membrane can be made to aid our attempts at treatment instead of hindering those attempts. Moyers' and Bauer's opinion on the cause of many treatment failures as expressed at the end of the above paragraph, I think, may be all too true.

G. Jacobson (7) carried out a survey to obtain the opinions of dentists and orthodontists on the matter of root resorption due to orthodontic treatment. He says that practically all teeth with resorbed roots are quite stable and unaffected, most being not excessively mobile. Few of such teeth suffer from progressive resorption resulting in exfoliation. It appears that some alveoloclasia sometimes occurs as a result of the proportionately lengthened crowns. This is of more significance than the root resorption. There is much division of opinion as to whether an endocrine factor exists. Orthodontic treatment is usually continued when root resorption is discovered. There is generally no great clinical significance except in cases of severe periodontoclasia. Tylman uses these teeth as abutments so long as root length is greater than crown height. Brodie considers that the matter is over-estimated.

Ideas on the causes of root resorption appear to be varied. Some say the shape of the roots, others an endocrine disorder, others the type of tooth movement, others the class of malocclusion, others disease and chronic illness, others the type of appliance.
According to Jacobson, (7), Strang says that "root resorption occurs most frequently when roots are forced into contact with the cortical plate of the alveolar process." Jacobson (7) says that excessive tip back bends cause it in lower molar and disto-buccal root of upper first molars.

The prognosis is usually most favourable.

Jacobson (7) presents this question of root resorption rather clearly. My opinion is that in the absence of much material on this subject, this paper may be taken as a good guide.

Bone is primarily a complex of calcium, phosphorus, carbonate and protein, states Sidney C. Werner (6). Osteoblast and osteoclast cells continually destroy and replace adult bone at an equal rate. The ingestion and absorption of adequate amounts of calcium and phosphorus and of protein or protein precursors, along with adequate calories are an obvious essential to bone health. Werner (6) continues by stating all the factors which influence bone health. These factors are rather numerous; I shall not list them here.

Werner (6) makes one realize the complicated mechanism of the human body and the number of things that can go wrong to upset the workings of one part of the body. This paper brings us back to a realization that we are working on a vital tissue and that, if treatment is not going according to plan, or there may be other indications, then it is wise to consult the patient's physician.

The etiology if malocclusion is rather vexatious. It would seem that only men with definite opinions on one or more particular causes venture to put same to paper. As etiology is so important,
it is unfortunate that more has not been written about it.

Hereditary factors, according to K. Hotz (13) are the most important causes of malocclusion. These factors may act directly on the teeth and jaws, and also indirectly through the constitution, growth, internal secretions, disposition to diseases, and psychic influences. Endocrine disorders have a profound effect on jaw growth, exfoliation of deciduous teeth and eruption of permanent teeth, but not on the formation of teeth. Endocrine disorders resulting in hypophyseal and hypothyroid dwarfism reflect orally in crowding of the teeth, prognathism, and under-development of the mandible. Cases of distocclusion exhibit more frequent and severe constitutional anomalies. The relationship is shown between the occurrence of V-shaped palates with endocrine dysfunction. Treatment orthodontically appears to aid the recovery of constitutional factors. Nutrition, particularly its effect on caries and function, is a large factor in malocclusion. Ironically, overnourishment appears to be worse than under-nourishment. Habits, early loss of deciduous teeth, and loss of permanent teeth are well-known factors.

Hotz has presented a most interesting paper. The contents of his section of "Habits" while more fully covered than I have indicated above, are well known to every orthodontist. However, of interest was his stressing of the hereditary, endocrine and nutritional factors. The latter two usually are considered of minor importance, local and secondly hereditary factors are usually considered first. While not necessarily agreeing with Hotz' order
of stress on certain malocclusion factors, he has presented more "food for thought."

Clifford Whitman (10) stresses the importance of habits as a malocclusion cause. He says that it is most important to discover the existence of any habit, which may be causing malocclusion before the commencement of treatment. If such a habit is not observed and corrected, then the prognosis, particularly in open-bite cases, is poor. The cause of a habit is usually some type of emotional upset which must be treated before the habit can be corrected. Whitman (10) emphasizes the value of co-operation with a pediatrician and psychiatrist. The orthodontist must learn what type of parents has the child, his or her general care, daily life, and health. Naturally prevention at the commencement of a habit is better than correction. Whitman (10) sets out preventive and corrective methods including the use of a "Reminder Lotion" and phenobarbital.

The paper by Whitman on the habits is quite sound, and serves to keep before us the dangers of these habits. Although stating the need for individual treatment, the use of "Reminder Lotion" and phenobarbital appears to be too common.

The etiology of the perverted swallowing habit is presented by Walter Straub (9). He quotes several descriptions of the normal act of swallowing and also describes very clearly the abnormal action. During correct deglutition the muscles of expression are relaxed, but the perverted act results in a strained appearance being presented by these muscles. This is the first method of detection.
The perverted habit is caused by improper bottle feeding instead of breast or correct bottle feeding. The habit usually results in open-bites, but may be present in other cases, such as Class II, Division 1, spacing, and contracted maxillae, where in such cases the habit is masked by another habit, or by the malocclusion resulting from another habit or cause. The perverted swallowing habit must be detected and corrected, otherwise treatment of malocclusion in such cases will surely relapse.

This article is well worth attention, as it very well reveals the perverted act itself, and also the results of it. I feel that two sections of this article are of importance; they are "The Description of the Perverted Act of Swallowing" and "Comment and Conclusion."

The problem of thumb sucking is the subject of a thorough study by A.G.H. Lawes (15). He says that it is a cause of dental deformity. From his study of cattle behaviour, analogies to humans have been drawn. Lawes' (15) idea is that the act is instinctive, substitute satisfaction and fantasy formation. Treatment requires complete parent co-operation, and he attacks the opinion of most psychologists and dental methods of correction. At the end of his paper Lawes (15) lists twenty conclusions to his investigations, which amount to the fact that the habit is psychological and is a cause or aggravation of dental deformity. Almost 24% of children observed were persistent thumbsuckers.

This thesis by Lawes (15) presents mainly a reaffirmation of what is already known on the subject.
However, his study covers all aspects of thumb-sucking and is most useful in being so comprehensive.

W.H. Littlefield (12) says that thumb-sucking may begin even before birth, may not be continuous but cease and recommence, may not begin until a few years old, and may be continued to adulthood. The main result is that the upper anteriors are pulled forward, and if the thumb uses the lower anteriors as a fulcrum then they are forced lingually, or the whole mandible may be forced distally. Open bite may occur if the pressure is up and down. Sucking of the cheeks during thumb-sucking results in contracted dental arches. It appears almost all thumb-suckers have a malocclusion caused or aggravated by the habit. Where no malocclusion exists bone character and other factors exist which have counteracted the habit. Good may be done by thumb-sucking where a tendency to inferior protrusion exists. There are numerous causes, the main ones being insufficient feeding, vitamin deficiency, retarded growth, and psychological. Treatment is designed for both prevention and remedy. It must be decided when prevention is necessary - a pacifier is often the lesser of the evils. It may be necessary to refer the child to a pediatrician. Remedial measures usually are not taken till five years, as any malocclusion will correct itself if the habit ceases by this age. Force is not helpful. Appliances succeed only when the child is taught to realize that they are to help him. Try to teach the child to help himself. The help of a pediatrician and/or a psychiatrist may be necessary. A change of environment is often useful, but not always easy.
Nagging and scolding must not be used. The cause of thumb-sucking must be removed before it successfully ceases. This habit occurs in 17% of children.

Littlefield (12) has written a really useful paper on thumb-sucking, which I feel would be very good for students. While not presenting new ideas, Littlefield (12) does concisely show the prevalence and results of the habit, and the lines along which treatment should travel.

The habit of thumb-sucking may be "meaningful" or "empty", and there is no transition from the first to the second according to E.S. Mack (14). He says the longer a fixed habit exists, the harder it is to break it. There are five main causes for habits which I will not list here. It would seem that all abnormal sucking habits stem from incorrect feeding of the baby. Jaw growth is governed by heredity and environment, modified by malnutrition, disease, pressure and trauma. Thumb-sucking is pressure. It unbalances and alters the form of the dental arches. Bottle babies are more apt to develop the habit. Sometimes some accessory movement or object accompanies the habit. If such an accessory is removed, then the habit usually ceases. Many psychiatrists do not believe in force to stop the habit for fear of a worse habit developing. In older children, it may be intellectual or emotional. As necrotic children are too unstable, restraint should not be used, otherwise however, restraint can be successfully used. Mack gives a list of twelve results of this habit, and also says that 17% of malocclusions have a history of thumb-sucking. Negative or positive training by the parents,
ill-tasting medicines, finger guards, braces, and removable intra-oral appliances are most ineffective. Fixed intra-oral appliances, such as the hay-rake, palatal bar, or palated crib, are usually effective. The former is particularly useful for countering a tongue habit tending to replace the thumb-sucking. The "meaningful habit" should be treated by the pediatrician, and the "empty habit" by the dentist; help is often needed from the psychiatrist.

This is another good paper on this subject, and Mack (14) gives some very useful material on the handling of this problem. I like very much his approach to the subject.

It is interesting to note the divergence of opinion, particularly in its treatment, on thumb-sucking. I feel that Lawes (15), and to a lesser extent Littlefield's approach, are rather negative. I must say that after reading the two former papers, that of Mack's (14) gave a brighter and more confident feeling on this subject. I do think that Lawes particularly has become over-psychological in his handling of the habit.

Nailbiting, according to M. Massler and A.J. Malone (13) has its incipiency between 3-12 years, but almost disappears in adulthood. 40% of all school children are nailbiters, this being a "normal" habit between 4-18 years. Persistent biting is a symptom of internal tensions. This habit is a tension reducing mechanism, particularly under situational stress. No proof can be discovered of its effect on the dentition. Symptomatic treatment is useless.
This was the only article read on the nailbiting habit, but this was not surprising, as it does not have any apparent effect on the dentition. The article itself gave a thorough review of the habit.

There are intentional or planned pressures, and unintentional pressures according to E.J. Klein (16). The latter are (1) intrinsic or pressure habits within the mouth, (2) extraneous or extrinsic-abnormal pressure habits on the face, and (3) functional pressures. Tongue habits, thumb-sucking, chin-propping, face baring, anaesthesia throat, incorrect swallowing habits, are some of the most common pressure habits. The face yields easily to stimulus and pressure. The transition period from the deciduous to the permanent dentition is when the most damage is done. The bone of a healthy child changes more readily than that of an unhealthy child. A biological as well as mechanical knowledge is required to obtain stable results. All abnormal pressures should be eliminated as they are harmful and will upset planned treatment.

This was rather a good article by Klein (16), which made one realise the dangers of pressures.

A. V. Fluhrer (19) says that poor sleeping positions and pressure leaning habits during the day are big causes of malocclusion. However, such pressure is only effective when the bone, due to illness or other factors, is not strong enough to resist them. Orthodontic treatment is unsuccessful while such causative habits continue.
Lying on the face, or pressure caused by arms and hands during sleep are the main troublesome pressures. Hypothyroidism, scurvy, rickets, malnutrition and other endocrine disturbances are all highly potent etiological factors which, in conjunction with pernicious sleeping habits, are among the most important contributing factors in dentofacial anomalies, and will cause relapse unless these conditions are eliminated. Photographs taken while the child is sleeping reveal that over 50% of children being treated, are exerting these pressures for over 50% of their sleeping time. Such intermittent pressures are sufficient to bring about changes. In these ways 20 pounds pressures are exerted, while orthodontic treatment pressures are only about 3 ozs. In overcoming these etiological factors, full patient co-operation is essential.

I was most interested in this paper. If his collation of material is correct, the degree of pressures applied while asleep in so many children is most revealing. It would suggest that further investigation may be fruitful.

Klein (16) and Fluhrer (19) have approached these pressure habits from two different points, with Fluhrer (19) concentrating more on nocturnal habits, and Klein (16) more generally. One marked point of difference was Klein's (16) statement that bone in a healthy child changes more readily than in an unhealthy child, while Fluhrer (19) indicated that bone in an unhealthy child changes more readily. I feel arguments for both viewpoints are strong; which is correct?
Ankylosed temporary teeth, according to E.T. Silver (17), result in displacement of the permanent teeth, particularly in premolar area. Such ankylosed teeth should be removed and the space maintained. Submerged teeth are nearly always ankylosed. Ankylosed permanent teeth result in other teeth moving to fill the space. All ankylosed teeth should be removed.

Permanent teeth, although displaced by ankylosed teeth, usually right themselves if the ankylosed teeth are removed and the space retained. Final therapy is often helpful for proper completion of the case.

Silver (17) brings to notice what damage can be done by ankylosed teeth and how often such damage is easily rectified if attended to in time. It is a useful paper on this matter.

B.N. Jager (11), over a period of years, examined over one hundred children who presented special orthodontic problems, with regard to endocrine or metabolic disturbance. 10% revealed endocrinopathy, all of which were hypothyroids of various degrees, except one hypopituitary. All the hypothyroids responded to thyroid therapy. 20% or more were congenital.

Various asymmetries of the face, orbit, optic nerve size, length of extremities, and size of the chest, will show a marked constriction of the oral cavity on the same or counter-lateral side with delayed dentition and crowding. A case of Turner's Syndrome, with typical understature, webbing of the neck, demonstrated marked recession of the mandible, delayed dentition, and delayed bone development.
The rest fell into the category of rapid growth in height with slow sexual maturation.

Root resorption, architectural abnormalities of the mandible and/or maxillae were common. During the period dietary or metabolic insufficiency can be caused by the rapid growth outstripping the supplies.

Jager (11) here reminds the orthodontist that such conditions occur, and may be encountered, at any time, although not continuously. The orthodontist should be on the lookout for them, but not find them where they do not exist. However, when suspect, consultation with the child's physician is necessary. The observations revealed in this paper are important and are useful in placing these causes of orthodontic cases and problems in their correct perspective.

Though all sections of orthodontics are really of equal importance, I feel that the diagnosis and analysis of our cases is the crux of orthodontics. Our failure or success in orthodontic treatment initially depends on our ability to diagnose and analyze our case. Naturally if we err at this stage, the prognosis for successful treatment must be lower.

Of this subject C.W. Carey (21) says that experience is necessary, as there are many variables, and analysis cannot be worked out mathematically. It must be decided whether to treat immediately, or whether to wait. In the deciduous dentition Carey limits treatment to Class III cases. He limits mixed dentition treatment to, anterior cross-bites and posterior cross-bites, simple premaxillary protusion, irregularities of upper anteriors,
maxillary protrusion Class I. with forward displaced mandible, true Class III cases, and space maintenance. Treatment is contra-indicated in the following mixed detention cases: discrepancy of tooth and bone, deep-bite, except for the use of a bite-plate in some cases, and in cases where secondary dentition treatment would be better. One must beware of keeping appliances on patients for too long, as the patients often tire of treatment. All casts must be measured for supporting bone and tooth structure size. Generally a less than 2.5 mm. discrepancy is treated without extraction, and over 2.5 mm. discrepancy with extractions. A history of the patient and parents, models, full mouth and cephalometric X-rays are necessary. Photographs may also be of much use to decide whether a change in facial form will improve or mar the profile and other facial views.

This is a very useful article and is of much help to the student. Carey (21) gives rather a good general idea of when treatment should commence and when to extract teeth, both points being rather contentious, and confusing to the student and even orthodontists. In some extraction cases Carey (21) discussed, he appeared to be a little unorthodox, but he seemed to have achieved the desired result.

Ashley Howes (23) writes of the importance of model analysis for treatment planning. He states that there are three main points to look for, (1) size and form of the basal arches, (2) the relationship of the teeth to those arches,
(3) the inter-relationship of those arches to each other.

On the first point the merits of expansion and lengthening of the arches is considered and can only be done where there is sufficient basal bone, otherwise extraction is necessary. Tooth material and basal arches must be balanced, and muscle balance also fully considered. The premolar width measured between the buccal cusps of the first premolars should be 43% of the tooth material from first molar to first molar. Basal arch width is slightly more when measured on models than when measured in the mouth (approximately 2 mm. more). A high percentage of the normal cases measured had tooth material in the low nineties, measured in millimetres. High nineties and over one hundred millimetres often accompanies the necessity to extract. On the second point Howes mentions the extraction of the maxillary second molar in maxillary protrusion cases to facilitate distal movement of maxillary buccal teeth. However, distal movement is often too much, so first bicuspids are extracted. This is done where a discrepancy exists between tooth material and base bone, or where such mesial movement of buccal teeth has occurred. Such conditions must exist before extracting teeth, otherwise there is a danger of spaces resulting. In protrusion cases muscle exercises are necessary to augment muscle balance during and after treatment, otherwise relapse may occur even with extraction.

Point three covers whether a case is Class I, Class II, or Class III. It must be decided which teeth and/or bases are in mal-relationship. In Class II forward growth of the mandible
can be obtained in certain cases as a result of treatment. Extraction is also necessary in some Class II cases. Where it is not possible to correct the anterio-posterior fit of the basal arches, a normal mesiodistal fit of the teeth is accomplished. Model data should be used in conjunction with cephalometric analysis, patient's appearance, and family background.

The information obtained from the models as shown by Howes (23) is most useful. A close appraisal of a case may thus be made from the models, with the finer points obtainable from ophthalmometric X-rays.

Evaluation, according to E.R. Strayer (34), is the initial consideration of a case as to whether treatment is, or is not, required. Analysis is the determination of the factors involved. In present day orthodontics a knowledge of classification and design of appliances is insufficient; a deeper study of basic causes and an understanding of the limitations of treatment is also necessary. Patient history, and parental and grandparental dental histories are valuable in assessing the future development of the patient. Cephalometric X-rays are required to determine the osseous development, relationship and position of the teeth to the osseous bases. Class II cases are the most variable cases. Strayer divides them into - type A, mandible distal with the posterior border close to the vertebral column, subdivision I, adequate mandibular growth, subdivision II, inadequate mandibular growth.
Type B, mandible favourably placed, sub-division I, adequate mandibular growth with mesially placed upper arch, subdivision II, inadequate mandibular growth. Type C, favourably placed mandible with the teeth and alveolar bone distally placed to the mandibular base.

Carefully made models give exact measurements as to the sufficiency of the base for the teeth. Thoughtful consideration of all phases of case analysis is essential to establishing a plan for successful treatment.

The main value in this paper is Strayer's (34) reiteration of the importance of diagnosis evaluation and case analysis. Of interest was his division of Class II cases; it seems to contain much of value.

These were the only three papers mainly concentrating on overall diagnosis and case analysis. There are following papers dealing with specific sections, but it was disappointing to find so few papers dealing with this subject as the above three papers have done.

Using the following measurements, slight over-bite 2 mms. or less, medium over-bite 2.5 mms. - 6.5 mms; excessive over-bite 7 mms. or more. Prakash and Margolis (32) found that the majority of all malocclusion classes had a medium over-bite. A small number had slight over-bite in normal and Class I cases, and less had severe over-bite, while in Class II cases a small number had severe over-bite and less had slight over-bite.
The extent of the over-bite varied with the relative vertical level of the anterior teeth as related to the posteriors. Variations in the vertical level of the lower molars and upper incisors show strong associations with variations in over-bite. The vertical position of lower incisor shows no correlation to position over-bite, while the vertical of upper molars shows a suggestive association with over-bite particularly in Class II cases. In other words, excessive over-bite appears to be associated with infra-occlusion of the mandibular molars, and to a lesser extent the maxillary molars, and with supra-occlusion of the maxillary incisors. Lower incisors are not in supra-occlusion in excessive over-bite.

This analysis of the over-bite problem is of much interest; it gives something definite as to the degree of over-bite, and also the fact that the posterior teeth and upper incisors are at fault, and not the lower incisors. These facts naturally enable one to analyse the case more thoroughly, and to better plan treatment.

Von der Heydt (20) discussed the recognition of true maxillary protrusion cases as opposed to true Class II cases. Various methods of treatment are proffered according to the type of case, including compromise treatments which are recommended in certain instances. His four subdivisions of maxillary protrusion are: 1) true maxillary protrusion, 2) maxillary protrusion with mandibular insufficiency, 3) potential maxillary protrusion, 4) mandibular displacement. The emphasis is placed
on distinction of these cases from Class II, division I cases as treatment is likely to be a failure if the diagnosis is incorrect.

Von der Heydt appears to approach these cases with a flexibility of mind which is so often lacking in American orthodontics. From this paper the importance of correct case analysis is obvious, as the whole treatment plan depends on this.

The fact of greatest importance shown by Arne Bjork (28) is the difference between basal prognathism, alveolar prognathism, and tooth inclination in facial prognathism. Each may be present singly or in various combinations, and may be in one jaw, or in both jaws. Whichever condition exists is most important to our method of treatment.

Although the determination of such prognathism is based on cephalometric analysis by Bjork (28), the main factor of importance is the analysis of the type of prognathism. An incorrect analysis could end in a very unfortunate treatment result.

Von der Heydt's and Bjork's papers were the only two on prognathism, but I feel that they were two very good papers, contributing something real to this type of case.

In this article W.B. Downs (22) concisely represents his method of analysis from cephalometric radiographs, and also he shows the difference between static and dynamic analyses and what may be gained from each. Static analysis compares the individual measurements with the normal measurements and are used to help assess a case. Dynamic analysis is a comparison of measurements
from progress radiographs taken before, during and after treatment, and reveals the progress and then the degree of success of treatment. Downs (22) points out that the forward and downward growth of the face along the Y axis is only the average normal. There quite often is considerable variation to this in actual growth. It is shown how this cephalometric analysis can aid diagnosis and report a case, but Downs (22) definitely states that it is only one part of the diagnosis.

This is an important article by Downs (22) in that it concisely presents his method of cephalometric radiograph analysis, and also shows the application of such analysis.

Cephalometric X-rays and their analyses are of much use if used correctly and in their place according to T.M. Graber (27). They are a great aid in determining growth and development, and they also reveal abnormalities. Skeletal and facial types are shown by these X-rays. A functional analysis is important, showing the freeway space and the movement of the mandible to closed occlusion. Graber states that each angular measurement as such means little, but taken together as a whole can tell much. Norms must be considered according to facial types and other variations. There are Skeletal Dysplasias, Dental Dysplasias and Skeleto-dental Dysplasias. In the analysis of these X-rays, the angle of facial convexity, apical base relationship, and the inclination of the mandibular plane are looked for in the Skeletal Pattern. Upper incisor axial inclination, lower incisor inclination to mandibular base bone, relation of incisors
to the occlusal plane, relation of upper and lower incisors to each other, relation of upper incisors to the facial plane measured in mms. are obtained from the denture analysis. These facts all help in the diagnosis of the malocclusion and so result in a better prognosis and treatment result.

Details of Graber's (27) analysis of cephalometric X-rays are given in his paper, and it is of much interest to compare them with Downs' analysis. I feel that Downs' analysis is the better of the two mainly because the points are better determined and his angles better obtained and analysed.

The accuracy of standardised radiography is shown by W.N. Benson (25). He also suggests the use of a second film taken with the mouth wide open, where an accurate condyle head tracing is required. Much interesting material on growth is presented by Benson, which has been mentioned earlier in this thesis. Of importance in diagnosis is the fact that the gonial angle actually does not change during life, the inter-relationship of the incisor and gonial angles to malocclusion, that in the majority of Class II, division I cases the mandible is of normal size, and that it would seem that Class I, division II cases are really Class I cases with the mandible forced distally by the lingually inclined upper central incisors.

This is a most interesting paper. The points obtained from this study of cephalometry are of much value.

Cephalometric Roentgenograms are used for determining bone conditions, presence of pathological conditions, symmetry,
normalcy, and other factors, according to L.B. Higley (29). He suggests the use of a transparency of normal for the particular age and sex to check against the patient's roentgenogram. By taking profilograms in centric, at rest, and with the mouth wide open for the condyle, it may be determined whether mesial or distal mandibular positions incenetric are due to tooth interference and/or other factors. Tooth inclinations may be determined, also the availability of bone to tooth structure and other factors, and finally the best method of treatment. Cephalometric roentgenograms are also useful as an initial record and for progress checking during treatment.

Higley (29) presents very little that is new in this paper except his use of a transparency of normal for basic analysis, which, I think, is useless as every person is so different that standardization to this degree is impossible. However, he does show how useful cephalometrics is and how much of the guess work is eliminated by this useful diagnostic and checking aid.

E.L. Johnson (30) says that in 1946 Tweed first used the Frankfort-Mandibular Plane angle from lateral photographs. This angle is now one of the main measurements in Downs' cephalometric table. Brodie and Wylie are quoted as saying that deviations from normal may not be abnormal for that individual. The random combination of separate facial parts, each in itself normal, often together result in "abnormal". Johnson (30) gives the linear measurements be used to explain why the facial pattern
is bad with an increased Frankfort-Mandibular Plane angle.

The clinical implication of this work is that the facial pattern is important in prognosis and treatment. It is hereditary or due to other deep-seated factors not susceptible to modification. There is much deviation from "normal" and many of these deviations are not within the realm of orthodontic correction. The magnitude of the Frankfort-Mandibular Plane angle is the result of relatively greater development in certain areas than others, and not as a biological entity in itself. The vertical elongation is primarily in the anterior part or profile with comparatively little elongation in the molar area. Johnson (30) divides the Frankfort-Mandibular Plane Angles into four groups: 1) $25^\circ$ or less, 2) $26^\circ - 31^\circ$, 3) $32^\circ - 34^\circ$, 4) $35^\circ$ or more; the latter group being of particularly bad prognosis. This angle is mainly effected by vertical development of the anterior alveolar process, length of the Ramus, and the infero-superior placement of the glenoid fossa.

Johnson (30) has written a most interesting paper on this angle, showing the importance and the influence it has on diagnosis and prognosis of treatment. It could be said to be the centre of cephalometric analysis.

Attention is focussed by M.B. Markus (33) on the position vertical of the lower incisors. He says that Tweed uprighted the lower incisors in order to reduce the danger of relapse. Others state that the lower incisors tend to return to their former inclinations. Markus (33) states that investigations
on normal and abnormal occlusion reveal the inconsistency of the 90° theory. The gonion and chin angles, the length of the rami, the bone in the chin region, the distance of the incisors from the chin plate, and the angles between the cranial and facial portions, should all be considered in procumbency. Morant is quoted as saying that correlation exists between gonial angle and the height and breadth of the ramus, and that there is a marked sexual differentiation which is not usually considered. Wylie is stated as saying that a 90° incisor-mandibular plane angle can exist with very procumbent incisors. Markus states that linear measurements are distorted in cephalometrics, also that there is an inconsistency in normal measurements due to the presence of angles within the teeth. The normally used long axis of the tooth forms an angle with the root axis as does the labial surface line from the incisial edge to the neck of the tooth, and also the tangent to the labial surface. Both upper and lower teeth have these angles.

Serious doubts are certainly raised by Markus (33) on Tweed's 90° theory, and he presents rather a strong case. However, I feel that he is "splitting hairs" when he goes into details about the angulation within the teeth themselves. I feel that if the tooth long axis is always used, a sufficiently accurate assessment can be obtained for practical purposes.

L.B. Higley (75) says that the theory of the lower incisors being 90° to the mandibular plane for normal occlusion or for stable occlusion following treatment is wrong, as such
exists in many gross malocclusion cases, and hence is not of
great diagnostic value in itself. In cephalometrics, use of
the Frankfort Plane and a line at right angles from the orbit
point will reveal prognathic or orthognatic types. Higley says
that Downs' measurements are very useful. According to him
cephalometric X-rays are very useful to record changes due to
treatment.

This is an earlier paper by Higley on cephalometrics.
He also writes on other matters in this paper, which will be
commented on later. It was of interest to note his opposition,
as well as Markus', to Tweed's 90° theory. Higley's remarks
appear to be generally very sound.

A cephalometric examination was made on Swedes and
Bantus by Arne Bjork (26). Using the nasion-sella turcica line
as the base line, he drew lines downwards from the nasion to the
nasal spine, the prosthion, the infradentale, and the pogonion.
The angles so formed and measured helped to determine the degree
of basal or alveolar prognathism, or a combination of both.
Interesting cases are shown revealing the degree of change due
to treatment. Bjork (26) also states that the cranial base
may be bent, and also the facial outline may be straight or bent.
The angle of the incisors is also considered.

The angles made by Bjork (26) are very useful in aiding
case analysis; however, it is unfortunate that he does not give
average and mean deviation measurements for these angles.

Factors effecting cephalometric X-rays are discussed by
J.B. Franklin (24). He says that the X-ray machine should be powerful enough to deliver 30 milli-amperes and 90 kilo-volts. Less powerful machines necessitate a greater exposure time with probable resultant loss of sharpness due to movement of the patient. Roentgen rays have a very short wave length and are affected by the density of bodies. Milli-amperage affects and determines the density of an image. The milli-ampere second is the basis of comparison for radiation. The kilo-volt is the electromotive force necessary for the electrons to bridge the gap from cathode to anode. They control the contrast of the films. The Coolidge hot cathode tube is the one used. The anode angle is 15° - 20°; less than 2% of the energy used produces X-rays, the rest being lost in the production of heat. The effective focal spot is 1.3 mms. to 1.8 mms. square in the dental X-ray machine. The smaller the focal spot, the longer the film-focal distance, the longer the focal object distance, the shorter the object-film distance, the sharper the image. In cephalometric roentgenography a focal-film distance of not less than five feet is required, with the object as close as possible to the film. Secondary radiation causes an obscuring of sharpness of detail, hence limiting devices such as cylinders, cones, and diaphragms are used. Cassettes with intensifying screens are used to decrease the exposure time, although they cause some loss of detail sharpness. Franklin (24) recommends an exposure time of 1.8 seconds with 30 milli-amperes and 60 kilo-volts. He also feels that it is better to have one's
equipment fixed, and move the patient if necessary.

Franklin (24) has written a paper of much practical value, particularly for the student or for the orthodontist about to enter the field of cephalometric roentgenography.

As a result of the use of cephalometrics no tailor-made plan of action has been evolved for any particular case according to Wendell Wylie (35). Cephalometric X-rays are very useful as records and to report a case. "They give us with a degree of precision unmatched by any other procedure, the ability to judge the relationship of the dental arches to their supporting bases, and to assess any changes in that relationship which may or may not have been affected". Rapid methods of evaluation of the facial pattern from these X-rays are available. Cephalometric X-rays are not necessary to practice good orthodontics, but they reveal more data, and they enable a better case analysis, and so allows one to be a little more sure of treatment.

Although this paper is rather verbose, it is timely in placing cephalometric X-rays into their correct perspective in orthodontic practice. These X-rays are of immeasurable value as an aid to diagnosis and analysis, but they are not the diagnosis and analysis.

The views expressed by the previous papers on cephalometrics were varied and of much interest. I feel that W.B. Downs (22) has so far presented the best method of analysing cephalometric X-rays, and also that Wendell Wylie (35) has truly placed these X-rays in their correct perspective and proportion. The
other papers all contribute worthily to the controversy of cephalometric X-rays.

Meyer Eggnatz (31) says that Broadbent's studies revealed that the jaws appeared to be decreasing in size, and that the result is crowding of the anteriors and impacted third molars, particularly in the mandible. Early and then six monthly follow up extra oral X-rays will aid in determining the possibilities of third molars eruption. At a recent discussion the following opinions were expressed: 1) less than half of the normal non-orthodontic mouths will have sufficient room for third molars, 2) orthodontic mouths have less chance still of sufficient room, so remove the third molars as soon as such a position is determined, 3) if a formula could be established to determine at a given age the space required from the second molar to the ramus for the prospect of normal future third molar eruption, it would be of much help. There are two diagnostic aids in X-ray interpretation: 1) if by 16 years of age the mesio-distal width of the upper third molar is greater than the bony tuberosity, then it will not erupt normally, 2) if root formation is complete and the lower third molar has not erupted, then it is not likely to do so, as the latter part of root calcification takes place after the bulk of eruption. If a lack of space occurs at the normal eruption time, and the eruptive momentum is lost, and root formation takes place, then the tooth is a bad risk. When the calcification of the roots of a third molar has taken place, it will not erupt within any reasonable schedule. If the occlusal
surface is shown in a good X-ray then it is in trouble, as it is facing buccally or lingually.

At first glance it would appear that Eggnatz (31) has rather severe views on third molars, but from the number of impacted and unerupted third molars seen in practice, I feel that he is not far from the truth.

According to Weinmann and Sicker (1) "during the last phase of molar eruption, disturbances in the correlation between the growth of the jaws and the eruption of the third molars occur rather frequently". Third molars are becoming rudimentary, and it seems that we are about to lose them. One or more of these teeth are often absent. This reduction of the dentition in length is but one phase in the reduction of the masticatory apparatus. The second phase is the reduction of the facial skeleton shown in a reduction of facial prognathism. The two reductions unfortunately are not always correlated, and it seems that the shortening of the jaws is further advanced than the shortening of the dental arch. "This reduction of space for the third molars is enhanced in many individuals by the fact that the third molars erupt at a time when the general growth and that of the jaws are nearly completed". The lower third molar is more frequently affected than the upper tooth. This is due to their respective positions and directions of eruption.

This section by Weinmann and Sicker (1) on the third molar is very interesting. When compared with Eggnatz's (31) paper on third molars, it makes me feel all the more that Eggnatz's
analysis of third molars is very near to being if not correct.

The papers classified under this section of Diagnosis
and Case Analysis gave some very good material and information.
It definitely appears that the emphasis is on cephalometrics, but
this is quite understandable when, to coin a phrase, one may
easily call this "The Cephalometric Age" in orthodontics.

Now we come to the problem of the treatment of malocclusion.
Different methods, appliances and systems have been devised,
many with extravagant claims, but all have fallen short of the
ultimate, and so we still strive for more efficient means of
treatment.

D. Mossberg (38) indicates that the basic principles of
orthodontics are more important than the use of a particular system
or appliance in orthodontic treatment. The limitations of ortho-
dontic treatment must be recognised. Each individual varies
according to the mating of his parents. The pattern of the jaw
bone, the structure of the trajectories, and the functional force
it will withstand, is set and cannot be altered by orthodontic
treatment. Orthodontic treatment must result in harmony of size
and number of teeth to the size of the jaws and balance of the
muscular forces. The ideal tooth movement is physiologic, but
orthodontically this is impossible. The best force in most cases
is a light continuous force, but in some cases a stronger inter-
mittent force is better. "Where resistance is encountered, it
is imperative to increase the time rather than the force".
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Mossberg (38) mentions some appliances, and indicates that they all have their uses in particular cases; he also disagrees with the development of partialities to the superiority of one system or appliance over another.

This is a most valuable paper in that it reminds orthodontists of the importance of the basic principles of orthodontics as opposed to the "cure all" faith some seem to have in their own particular system. While it is recognised that a particular appliance will most successfully treat the majority of cases in a particular orthodontist's hands, the importance of the basic principles and an open mind must be stressed.

One of the first objectives in treatment should be the prevention of malocclusion.

K.T. Adamson (56) states that there are two possibilities, 1) either preventive orthodontics is not possible, or 2) if it is possible, it is not successful in attaining its objectives as generally practised to-day. The beginning of malocclusion is one, or a combination of heredity, evolution and environmental or local factors. The preservation of temporary teeth, space maintenance and plates are the main preventive measures. General practitioners must be orthodontic diagnosticians. Protrusive or retractive jaws will not correct themselves. Pedodontia and preventive orthodontics are closely allied. Public education is very necessary for such work to be done.

The lack of knowledge on preventive orthodontics is sharply shown by Adamson (56). His exhortation to remedy this
problem should result in renewed thought on this phase of
treatment.

Using several cases, H.L. Shehan (77) shows what can
be done with a minimum of treatment and observation. Lingually
erupting lower anteriors are corrected by the removal of the
offending deciduous teeth. Lingually locked upper incisors are
corrected by using a wooden spatula. Hawley retainers are used
to correct pseudo Class III malocclusions. A Kesling positioner
is used to correct a pseudo Class III case with inlocking of the
maxillary teeth due to habit. Protrusion of upper anteriors is
corrected after cessation of thumb-sucking. An anterior open
bite was corrected after a habit of rolling the tongue stopped.
Two supernumerary central incisors were removed to allow the
other to come to their correct positions.

It is shown by Shehan (77) that once habits were broken,
or interference to good tooth position is removed, the malocclusion
corrected themselves quickly with little or no other treatment.

H.L. Shehan and E.A. Cheney (79) correct all crow-bites
in the mixed dentition stage. Labial cross-bites are corrected
with a tongue blade. Some conditions, even individual teeth
cross-bites, will right themselves. Lingually erupting lower
anteriors right themselves when the obstructing over-retained
deciduous teeth are removed. The Hawley incline, interdental
ligation, plastic or metal inclines cemented to the lower incisors
are all useful appliances at this stage. Of course, patient
co-operation is essential. Habits must be broken, and it is
surprising the improvement afterwards in buck teeth and even open-bites. Protruding incisors in Class II, Division I, cases are retruded mainly to avoid fracture. Oral screens are very useful for this treatment. The Class II relationship may be corrected if there is a good chance of stability. However, in no case is extensive therapy carried out in the mixed dentition as retention is too long and burdensome for the child, and the finance involved too much for the family.

A most useful paper is here presented by Shehan and Cheney (79). However, it contains much that has already previously been presented by Shehan (77).

Many cases can be wholly or partially treated in the mixed dentition period whatever their classification according to F.T. Barick (60). Practically all incidental irregularities may be treated. The only cases not advisable to treat are inadequate or shortened arches and extreme conditions, which usually need re-treatment or completion later. No hard and fast rules can be made, and it does not matter what appliance is used. However, McCoy tube attachments, plain, round labial arch wires, lingual arches, and Hawley retaining plates, seem to be the main appliances used in the cases quoted. The main idea is to aid nature along the right track.

Barick (60) gives stimulation of thought on treatment at this period, as it is obvious that if appliances can be fitted, treatment would be easier due to the stage of growth and "pliability of the bone."
Adamson, Shehan, Cheney and Barick are brave men to present material on prevention and mixed dentition treatment, as it is a ticklish problem, which many very experienced orthodontists admit they know very little about.

The history of the development of anchorage and an appraisal of present-day anchorage is presented by W.C. Sandusky Jr. (43). He reminds us of the different forms of anchorage as found in Dewey and Anderson's textbook. Methods of obtaining anchorage are mentioned, e.g. by edgewise arch, twin-wire, pin and tube, lingual, and acrylic appliances, and also Tweed's dynamic anchorage. His opinion is that extra oral anchorage could be made use of more often, and mentions specific cases where it could be of more use.

Nothing new nor outstanding is presented by Sandusky (43) as it is merely a resume of the history, type and methods of anchorage. However, he does remind us of the importance of stabilised anchorage and the methods of obtaining such anchorage.

Wilbur J. Prezzano (41) deals with the problem of slippage in the mandibular arch when intermaxillary elastics are used. Replies to a questionnaire were received from fifty-four orthodontists. The main techniques used were edgewise arch and twin wire appliances. The mandibular anchorage used was edgewise arch, lower lingual and other labial appliances. Some adjunct to the mandibular anchorage is used by the majority. Few use headcaps, due mainly to the lack of patient co-operation. The majority measured the force of the elastics. While some used
much greater forces, the maximum optimum is considered to be four ounces. The majority stated that they at least get some degree of slippage, and were not, or were not entirely, satisfied with their anchorage. In Class II cases the lingual appliance — the fixed of Dr. Johnson or Mershon’s semi-removable — is most commonly used. The edgewise arch appliance probably gives the most stable support, but every tooth needs separation and tends to affect the periodontal fibres, so diminishing the stability of the teeth. The use of a semi-fixed acrylic plate is described, and seems rather useful. The extraction of premolars after slippage and realignment in maxillary protraction cases is mentioned. Lowrie Porter is quoted in stressing the danger of pitting too many maxillary teeth against the mandibular anchorage, even when moving the six anteriors back in maxillary protraction cases.

The problem of mandibular anchorage is rather well discussed by Prezzano (41). Some useful ideas may be gained from this paper, and some pitfalls thus avoided. The cross-section of opinion is most interesting, as is also the use of an acrylic plate to aid the anchorage.

According to H.E. Strange (63) anchorage depends on the occlusion of the teeth, root surfaces, quality of bone, the periodontal membrane, the appliances and the way such appliance is used. Class II treatment presents the main worry. The lingual fixed wire is not sufficient and can easily slip. A fixed lingual appliance with a labial arch is often good. Do not
include the incisors in anchorage. Stable anchorage is harder to obtain in mixed dentitions. Elastics are used at night only, or use strong intermaxillary elastics at night with extra-oral anchorage. In the permanent dentition full banding is used with extra-oral anchorage at night, and elastics during the day. Keep a check on contact points, as these may slip. Tooth separation prior to fitting bands often causes forward movement of teeth with consequent weakening of anchorage. Strange believes that the edgewise arch appliance gives the best anchorage.

Strange (63) shows some of the dangers of the anchorage problem, and also shows how to reduce to a minimum the possibility of slippage.

A paper by L.B. Higley (75) has been discussed previously but some points from it on anchorage are pertinent here. He says that the maxillary posterior teeth cannot be moved distally, particularly by intra-oral anchorage, not even Tweed's dynamic anchorage.

In such attempts the mandibular arch slips forward. The use of a stabilising plate is most helpful. It has pins for lingual attachment to the molar bands. It is very good for Class II cases, especially where extraction is part of the treatment. Upper and lower plates may be used. It forms the best anchorage by welding the teeth almost into one unit.

Higley's (75) opinions on anchorage, I feel, are very close to the truth. I think that his stabilising plate for the lower arch bears much consideration.
A.J. Cunliffe (57) describes his method of obtaining mandibular anchorage in Class II, Division I cases. As his paper is nicely concise I will not present a resume here as it would be rather meaningless, so I will comment only.

Cunliffe's (57) methods seem to have much substance. They seem particularly useful in the deciduous and mixed dentition stages when stable anchorage is most difficult to obtain.

The problem of anchorage where there is a missing tooth and the space is to be maintained is dealt with by A.T. Fingeroth (64). The example used is that of a missing second bicuspid, which is a most common case. Bands are made for the first molar and 1st bicuspid, and a cylindrical band made to fit into the space, and is soldered (or welded if stainless steel) to the other two bands, being also cleared of the occlusion. Self-curing acrylic is adapted, moist cellophane placed over it, and the patient closes. After five minutes remove, and allow it to bench cure for 15 minutes. Trim, grind in, and cement to place. Tubes and brackets may be fitted to the bands for arch wires, both labial and lingual. This greatly aids anchorage and also aids function, also aesthetics if in the anterior region.

This is rather an ingenious aid to anchorage in such cases and also helpful psychologically where aesthetics are concerned.

B.G. Nelson (46) shows the uses to which extra-oral anchorage may be put. It may be used for increasing arch length, decreasing arch length, changing the mesio-distal relation of
upper and lower teeth, an auxiliary to intra-oral anchorage, retention after tooth movement. Intermittent pressure, which is usually most desirable, is very effectively applied by extra-oral anchorage. It is the only true stationary anchorage, and can cause distal movement of teeth, or retain buccal teeth while the arch grows forward, without disturbing the teeth in the other arch. It can be used solely or in conjunction with inter-maxillary elastics. The main objection is from the patient, but as it is usually necessary to wear it only at night, this objection vanishes. Also there is not the necessity for so many bands. The light intermittent pressure results in no soreness or looseness of teeth, and is the closest to biological tooth movement.

This is a most convincing article by Nelson (46) on the advantages of extra-oral anchorage. By the extent to which it is again being used, although more refined, it is obvious that its advantages as a means of anchorage are being realised.

D.A. Clisson (72) says that renewed interest in extra-oral anchorage is due to Oppenheim. The intermittent force obtained from its use at night only is most successful. It is very useful in Class II cases at 4 - 6 years, particularly those with maxillary protraction. There is no disturbance of the lower arch as when Class II elastics are used. At 4 - 10 years the second deciduous molars are the anchor teeth. The indirect force on the first permanent molars does not result in decalcification, and does not effect the incomplete root formation. It is also very good for
unilateral force. If used in the mixed dentition period, the eruption of maxillary second molars is sometimes retarded, but they do not become impacted. If, as should be done in the permanent dentition, the elastics have an upward pull, the roots move distally ahead of the crown. A downward pull results in distal tipping of the crowns. In 15 - 18 years old's elastics are often needed during the day as well. Another method is if third molars are present, remove the second molars, and the third molars invariably take up a good position. In severe bimaxillary protraction cases where four premolars are extracted and it is desired to pull back the anteriors without applying force to the posteriors, the headgear with two traction bars and mouth pieces is very successful. A light elastic with a long pull is usually better than a strong elastic with a short pull. It requires more force to pull all the teeth back than if applied only to the molars. It required 3 - 6 months with good co-operation to see much noticeable change in molar relationship. Excessive force results in spacing. Rotations of anterior teeth often correct themselves as buccal segments move distally. Molar bands must be well fitting, and tubes are .040 and aligned so that the archwire lies at the gingival third of the anterior teeth. An arch-wire is used with a fixed or welded stop. Round buccal .040 tubes are soldered to the arch-wire distal to the cuspids for the mouth piece, which is simply an auxiliary arch to which is attached the traction bar. This bar is of .070 stainless alloy and attached to the mouth piece by a swivel joint. One and a half
inch black belting is used for the headcap, and hooks of .030 annealed wire. The headcap is better for young patients, and is good for guiding their alveolar growth. There are longer intervals between visits, positive control, positive improvement in Class II cases, and eliminates disturbed anchorage.

A thorough paper is here presented by Glosson (72) on the headgear. Its worth is very well presented, and the paper makes a useful contribution to practical orthodontics.

From these papers on anchorage it is obvious that there is a long way to go before fully satisfactory anchorage can be obtained in all cases. From the last two papers, and also other recent orthodontic indications it is obvious that the trend is towards extra-oral anchorage. This is a good step as, so far, I feel that it is the most stable anchorage that we have today.

B. L. Herzberg (44) in his paper on the Tweed Philosophy goes into much detail regarding the angular requirements of the lower incisors to the mandibular plane, and the Frankfort mandibular plane angle. A series of illustrations are presented with models and photographs showing the Frankfort mandibular plane angle and results. Details are given of treatment in both non-extraction and extraction cases. .016 then .018 or .020 round arches are used first. At this stage rotations are carried out and spaces are closed, and also major irregularities where possible are rectified. A rectangular
arch with last molar tip-back bends and second order tip-back bends, is then fitted to both arches. Class III elastics are used to prepare the mandibular anchorage, and then Class II elastics to carry out treatment. Vertical elastics are then used to seat the cusps, and then final positioning arches or a Keeling positioner is used to adjust vertical inclinations. Finally retaining appliances are fitted.

In cases where the four first premolars are extracted, upright the buccal teeth after the extractions with 0.016, 0.018, 0.020 and then 0.021 x 0.025 arches. The rectangular arches have tip-back bends and vertical loops. When the cuspids are pulled back, the incisors usually follow. Plates with finger springs are good for doing this. Then close the remaining mandibular spaces and prepare the anchorage with a maxillary rectangular stabilising arch and Class III elastics. Then stabilise the mandibular arch and use Class II elastics. If the midline needs adjustment, then use Class III elastics on one side and Class II elastics on the other.

This paper is merely a reiteration of the Tweed Philosophy containing nothing new on this philosophy. Herzberg (44) is rather incongruent with his title in that he takes up too much of his paper talking about angles. Actually, if one has read other good papers on the Tweed Philosophy, this article is not worth reading.

The Tweed Philosophy is the subject of another paper by B.L. Herzberg (48). Firstly he gives the basic steps of band
forming, and then arch forming techniques. No expansion is
given to the arch except in cross-bites, or for individual teeth.
.016, .018 and .020 arches are first used followed by .021 x .025
arch, and sometimes .022 x .028 arches. The mandibular arch is
prepared for anchorage first. The lower incisors are uprighted
over basal bone, and a distal lean given to the buccal teeth.
The same tip-back bends are used for upper buccal teeth. Class
III elastics are used to obtain these movements, succeeded by
Class II elastics for actual treatment. In mid-line discrep-
ancies Class II elastics on one side, and Class III elastics on
the other are used as required. The closure of spaces in extrac-
tion cases may be done by sectional arches and vertical loops, or
lingual arches followed by full banding, by labial coil spring,
or short coil spring, or by a Hawley plate. If roots are
divergent adjacent to extraction spaces, gabled roof arches may be
used to rectify this.

This paper by Herzberg (48) is again basically a repeti-
tion of other writers extolling the Tweed Philosophy. While
this idea of treatment may be very good, it is a pity that those
writing on this subject do not present some new progress in
their articles.

Herzberg (48) concentrates on the treatment of Class II,
Division I cases and mentions bimaxillary protrusion cases, but
then conveniently forgets all about the latter type of cases and
all other types of cases.

These were the only two articles read on the Tweed
philosophy for this thesis. Fortunately for myself I had previously read material on the Tweed Philosophy because I was not particularly impressed with Herzberg's two articles.

W.H. Oliver (91) writes of the labio-lingual technique. He says that the molar bands must be well constructed with well placed buccal tubes and lingual vertical \( \frac{1}{2} \)-round tubes. The lingual arch must be semi-rigid, the bands should be rounded right angles, as many teeth as possible should be contacted and should be a single plane occluso-gingivally. A labial arch should always be used and only contacts the incisor and cuspid teeth allowing individual tooth movement and lateral growth and development. Auxiliary springs and other attachments are used as necessary in each case. An occlusal guide plane (not a bite plane) is attached to the upper lingual arch. It is used in Class II cases and guides the mandible forward so that there is only one occlusal closure, leaving the posterior teeth out of occlusion to further erupt. The former point is its main advantage over bite planes. Lunsford's and Terry's work shows strong evidence of growth along the entire posterior border of the mandible which is an active growth centre, into early adulthood, and especially in the neck of the condyle. Some change is certainly made in the Glenoid Fossa. It is stressed that the occlusal guide plane is not a panacea, and that intermaxillary elastics are always used with it. Failures are mainly due to misunderstandings of its construction, and of its capabilities.

It is unfortunate that this was the only article read on
this treatment technique. It would appear that Oliver (71) has presented a most efficient method of treatment. Of much interest was the use of the occlusal guide plane and the mention of the work of Lunsford and Terry.

The next three papers, the first two of which I have summarized in some detail, deal with the Andresen appliance, I have made comparatively long summaries, as it is at the moment most controversial, and these papers have relatively fixed in my mind the true value of this appliance.

O.G. Hooton (54) states that the Andresen removable appliance is used at night, making use of function to move teeth. It is a bio-mechanical appliance which acts on the teeth and alveolar processes, and is growth promoting and growth permitting. Tongue and thumb habits are prevented, and muscles are developed with this appliance. Centric and working bites are taken, the latter being used in making the appliance. After waxing up, the appliance is removed from the model, processed, and then adjusted to the model. In Class II, Division I cases the following adjustments are required, a) to obtain distal movement of the upper anterior teeth relieve the plate lingual to the teeth and on the palate, b) to obtain distal movement of the upper posteriors relieve the distal embrasures, c) to induce mesial movement of the lower posteriors relieve the mesial embrasures, d) to induce mesial movement of the lower anteriors leave the appliance in contact with the lingual of the teeth and adjacent bone. The appliance is constructed with the mandible protruded,
so applying distal pressure to the upper teeth and mesial pressure to the lower teeth, e) to obtain buccal movement of posterior teeth inclined planes are cut.

The appliances are adjusted every six to eight weeks, and one appliance works itself out in twelve to eighteen months when a new appliance must be made. A coffin spring may be used to widen the appliance when it is worked out in arch expansion. Otherwise it is adjusted the same as for buccal movements. In Class I cases the working bite may be retrusive or protrusive, but if in doubt use protrusive. Class II working bite is protrusive, and Class III is retrusive. To correct the median line, the working bite should have it corrected. The degree of opening of the working bite depends on the case, but is usually about 1/8 inch. The protrusion distance of the working bite is usually 1/8 inch, and if more is required, the successive new appliances are needed. Retrusive distance is the most retracted position of the mandible (in the normal bite the mandible is slightly forward of this). In raising the bite cover the teeth, which are not to move occlusally, and uncover the teeth required to move. Lingual movement of posterior teeth is obtained by relieving the lingual wall of the appliance and permitting the muscles to do the rest. Labial movement of the lower incisors is obtained by leaving the appliance in complete lingual contact with the incisal edge covered; unlimited or limited labial movement may be allowed by carrying, or not carrying, the appliance over part of the labial surface. The appliance is used to assist
the eruption of unerupted teeth to guide them into position, and is also used as a space maintainer. Springs are used to move teeth in the opposite direction to which the majority are being moved, or to rotated teeth. Follow-up wires are used. Extractions are carried out in the necessary cases. Hooton (54) lists only one main disadvantage and twelve advantages; he also shows some cases. The disadvantage is the possibility of the lack of patient co-operation.

His appliance appears to be useful, but I think it could be dangerous like all other appliances in the hands of an operator who has not sufficient knowledge of orthodontics. In the treatment of Class II, Division I cases, the mesial movement of lower teeth is just what is not required, but a mesial movement, if possible of the mandible as a whole, is required. I would be most interested to see some bone growth promotion cases. Hooton's (54) uneven extractions seem to be bad practice. Finally I would say that this appliance is not the panacea as has been claimed, but may be useful in selected cases, also it would seem that treatment is based on a generalized diagnosis instead of one obtained from thorough study of models, intra-oral and cephalometric X-rays and history.

Arne Bjork (66) writing on the Andresen method divides his cases into five groups.

Group I. Pronounced maxillary overjet with normal overbite, normal inclination of the incisors, and normal spacing. The activator is made with the lower jaw in protrusion and open
to the rest position. The activator will cause a reorganisation of alveolar bone, and the teeth to bring about a normal relationship. It will not cause the mandible to take a permanent forward position due to change in the condyle head. When used in the deciduous dentition, and to a lesser extent in the mixed dentition, it may result in some basal bone change, but not when used in the permanent dentition.

Group II. Maxillary overjet with deep vertical over-bite. The working bite is the same as in Group I, but is opened a little more. After processing the activator the occlusal surfaces of the lateral teeth are ground down so that they will erupt occlusally and buccally. This is most effective in the deciduous and mixed dentition and during the eruption period of the permanent dentition. The earlier it is used the more effective it is.

Group III. Pronounced maxillary overjet, with spacing of the upper incisors and normal over-bite. In all these cases where the upper incisors are being moved back, the labial arch wire is used actively. In many cases the upper first premolars are extracted. Construction bite is protrusive with the vertical opening dependant on the over-bite. The labial arch wire is active, and the activator is relieved lingually including the alveolar area. Auxiliary springs to the canines may be used as well. If the lower incisors need rearrangement, gutta-percha may be placed between the plate and the teeth and alveolus. This also opens the bite a little more. After active treatment the plate is used for retention, the gutta-percha being replaced by
self-curing acrylic. This method of treatment is very successful in these cases for all dentitions if the bite is not deep, but treatment is limited in adults with deep over-bite.

Group IV. Mandibular overjet. Construction bite is with the mandible forcefully retracted. The arch wire extends to the labial surfaces of the lower incisors. While still in wax, the part covering the lingual of the mandibular incisors and alveolar process is cut away. Guided eruption is also used. The arrangement and labial version of the upper incisors is controlled by lining the lingual with gutta-percha or using a small adjustable spring. Good results can be obtained in the deciduous dentition, however, the mixed dentition is better, as eruption can be controlled. The results are obtained by reshaping the alveolar arches during growth, and raising the bite. Good results in adults can be obtained in conjunction with prosthetic reconstruction. Treating these cases depends on the growth pattern.

Group V. Transverse or lateral malocclusions. For the expansion of the mandible and maxilla a precision screw or coffin spring is used. If the acrylic is ground away from the occlusal surfaces of the posterior teeth, then an intermittent expanding wedge action is obtained when the jaws are closed. For unilateral expansion line that side with gutta-percha or use small springs. If the mandible as a whole is displaced transversely remove cusp interference and make the activator in the objective normal. In arch expansion in the deciduous and mixed dentition
this method is good, but is not effective in the permanent
dentition. This method of correcting transverse displacement
of the mandible is quite good.

In all cases the activator is used at night and should
be used for one waking hour as well.

Bjork's (66) disadvantages are 1) impossible to use for
an unco-operative patient, 2) a greater selectivity of cases is
necessary than with fixed appliances, 3) age is a factor in some
types of treatment which will prevent its use, 4) If crowding is
of a marked degree, its use is limited.

This is a very thorough article on this appliance. It is
written by a highly respected orthodontist who has used this
method extensively in conjunction with thorough diagnosis.

Bjork's (66) list of disadvantages plus his statement that "the
activator method does not constitute any simple mode of treatment"
should squash any ideas, firstly that this is the only orthodontic
treatment, and secondly that it can be used successfully for
laboratory or massproduction orthodontics. It is quite apparent
that this method has its uses, but so has every other appliance,
particularly more so has the fixed appliance.

The principles of the Andresen-Häupl activator and the
Schwartz removable plate are given by O. Hopfer (47). He presents
many modifications such as division into two and three parts, the
use of the screw as well as the coffin spring for enlargement,
loops and hooks are added to the arch wire, double and wide loops
are used, and for wedges gutta-percha and Kerr's paste is used.
The different appliances are better in different cases, also combination use in varying degrees has been found of benefit. The active mechanism is not the increased action of certain muscles, but their increased tone. Intermaxillary elastics may be used with these appliances, which can be used in the majority of cases. However, certain cases are still better treated by fixed appliances, particularly cleft palate, marked rotation of individual teeth, and open-bite due to rickets.

For anyone who knows little of these appliances the article is most difficult to understand, otherwise it is of some use. The results shown seem to be reasonably good, but the models do not reveal the good results seen with fixed appliances. These appliances have their uses, but not to the extent indicated by Hopfer (47).

Of the three articles above, Arne Bjork's is definitely the best, as it gives a more unbiased opinion of the Andresen activator. I must say that I am in very close agreement with Bjork's appraisal of this appliance as may be gauged by my comments on each article.

Writing on the Kesling Positioner, W.A. Elsasser says that Dr. Kesling designed his appliance to place the teeth in form, harmony and in equilibrium with the forces acting on the denture. It is made by cutting the teeth from the original cast, then setting them up as required, and then making a rubber mould. Originally it was intended as a retainer, but being elastic it is not fully satisfactory. It is best used, however,
for six to eight weeks following band therapy, and then replaced by ordinary retention appliances. It is essential that after treatment equilibrium is attained as malocclusion is in equilibrium. Anterior teeth cannot be moved linguually to any great extent, particularly the lowers, nor can buccal segments be much expanded. Lower cuspids must not be expanded beyond their basal support, and posteriors, particularly lowers, must not be moved distally unless there has been an original mesial drift. If there is insufficient room for teeth over the base bone, then extraction must be considered.

The weaknesses of the Kesling Positioner are 1) a closed bite is caused by the force of the posteriors on the appliance unless in setting up the teeth for making the appliance the anteriors are depressed another 1-2 mms. so that the posteriors are free of pressure. 2) If patient co-operation is lacking, then the positioner is useless. 3) The appliance in many cases won't close spaces nor achieve proper interdigitation of the teeth. The main cause of this is that the basic appliance therapy has not been carried out as it should have, and too much has been expected of the positioner. Retention is necessary against the forces of occlusion while the bone is recovering, and it is almost useless against equilibrium forces.

This was rather an interesting article. Commenting particularly on the stated cause of the third disadvantage, I would say that if the basic appliance therapy has been properly carried out and the diagnosis correct, then use of the Kesling
Positioner should be unnecessary.

F.J. Loughlin (45) advocates the use of the twin-wire and edgewise mechanisms with occasional use of the round wire. He suggests the use of molar-width brackets and the placement of cuspid and bicuspid bands more gingivally for retention, with alteration of the bracket position accordingly. He uses a removable spring to rotate teeth, excepting molars for which he adjusts the arch wire, and the molar sheaths are shaped to take rubbers or ligatures. An incisor with an irregular edge is extruded, and the edge is ground, while a vertical loop is used to close a diastema between centrals. Lost or missing teeth, particularly anteriors, are temporarily replaced by a fitted acrylic tooth cemented to a band soldered to bands on each side, thus facilitating the maintenance of the gained space. Loughlin (45) states that in Class II, Div. I cases he moves the upper teeth distally as forward movement of the mandible is not often accomplished except in early treatment. He thinks that the forward movement idea is outmoded. The treatment of Class I and Class II, Div. I cases, where extractions are necessary, is carried out with the aid of vertical loops and the edgewise arch. A removable traction spring is shown for the mesial or distal movement of a tooth.

Loughlin (45) has written quite a useful paper containing a few good ideas. However, his opinion on the forward movement of the mandible is to a degree questionable. The use of the edgewise arch in the treatment of extraction cases to the extent Loughlin does, seems unnecessary as plates and lingual appliances will
achieve most of the movement.

The use of the split tube and lock and swirl tube attachments is recommended by A. Sved (62). The split tube and lock attachment consists of a tube with a split, which is soldered to the band. A smaller tube with a flange is threaded onto the arch wire. The arch wire is placed in the larger tube through the split, and the smaller tube pushed into place, thus locking the wire. The swirl tube has a split diagonally, and once the arch wire is slipped into it, it is locked automatically. These attachments may be used completely or in conjunction with a modified edgewise mechanism. They are especially useful for rotations, being much better than ordinary ligature brackets.

These seem to be very useful attachments, simple to use and yet positive in action.

The importance of the retraining and sufficient use of the musculature coincidental with orthodontic treatment is stressed by C.G. Glasser (39). He shows that with correct utilization much can be achieved with a relatively small degree of appliance therapy. He presents a slightly altered design for a bite plate for use in Class II Div. I malocclusion. The flat bite plane is carried sufficiently posteriorly so that the lower incisors must contact it. The anterior edge just lingual to the upper incisors is sharply bevelled. In attempting to find the most comfortable position, the lower incisors slide into the depression between this bevel and the upper incisors, locking the lower jaw in a forward position. Glasser (39) also stresses the importance of eating food which requires some mastication instead of only mushy food. He also points
out that there are two ways of swallowing, one for solids with
the teeth together, and one for drinking liquids with the teeth
apart.

Glasser's (39) use of the muscle forces and his training
of the muscles to act correctly, again brings forward the influence
of these forces in treatment and retention. The adjustment he
makes to his bite-plate could well be of use in treating Class II,
Div. I cases, provided that the muscles were trained first to act
correctly, otherwise the lower incisors may be caused to lean
forward instead of the mandible being repositioned.

Malfunction of the muscles usually accompanies malocclu-
sion as a cause or result according to V.P. Webb (52). If such
malfunction is not corrected, then retention of the case is more
difficult, and a greater danger of relapse exists. In planning
treatment, the following steps must be planned 1) appliance therapy,
2) corrective exercises for muscular balance, 3) correct nutrition,
4) habits corrected. All the muscles which have a bearing on the
dentition are listed. They include all facial muscles, and also
the platysma, internal and external pterygoids, the temporal, the
masseter, and the tongue. The picture of deficient nasal breathing
and excessive mouth breathing is shown. The following corrective
exercises are detailed, 1) establishment of normal lip closure,
2) pterygoid exercise, 3) masseter-temporal exercise, 4) tongue ex-
ercise, 5) general tonic exercise, 6) orbicularis-oris exercise,
7) Wilson's exercise, 8) swallowing exercise, 9) mandible restraining
exercise (or platysma exercise), 10) lip blowing exercise, 11)
lip elongating exercise.
I consider that Webb (52) has presented a very comprehensive paper on this subject, which is of much use to both the student and the orthodontist.

A. Rogers (68) is of the opinion that growth potential, family likeness in facial shapes, and other such factors must be considered when appraising a case from the myofunctional concept. He feels that nutrition is of vital importance, and that posture (both nutritional and psychological) is a cause of muscular malfunction. Orthodontic treatment must be approached from the psychological and physiological as well as the mechanical viewpoints. Part of this paper would suggest that Rogers is against extractions.

The title of this paper is very misleading as it discusses very little except high ideals, and deals only slightly with myofunctional therapy. There is much truth in what Rogers (68) has written, but it certainly cannot be connected with the title.

It would seem that more general attention to, and training of, the musculature during orthodontic treatment would be of more assistance than it is at present realized. I would venture to say that if a survey were made, orthodontists would be surprised at the prevalence of muscular misuse and malfunction.

Expansion beyond the basal bone mostly relapses according to H. Chapman (53). Base bone size is hereditary, so if base bone is less than the tooth material, then extract teeth. Extraction of a lower incisor decreases the size of the lower arch allowing the upper arch to decrease in size, as both are inter-dependent. Lower
incisor extraction usually gains little except when completely shut out of the arch. In Class I cases do not remove lower teeth unless completely out of the arch, or space equal to, or greater than it exists in the upper arch. Extraction of upper deciduous canines is often helpful. Class II, Div. I cases present both normal and abnormal bones. If the base is small, an upper tooth each side is removed, but lower teeth are removed only if completely out of the arch. Very rarely are extractions carried out in Class III cases.

A poor tooth is better removed than a sound tooth. Symmetrical extraction is not necessary, as many cases are not symmetrical on each side. A badly placed tooth should be removed in place of a well aligned tooth - even an upper second incisor in place of a pre-molar. Teeth distal to a space should be kept if possible in place to allow mesial teeth to take up their position first. In the case illustrated (2) and (4) were removed, as (3) did not come into line well, (4) was removed also. An upper first incisor may be removed in some cases. In cases of prominent central incisors, if the lateral incisors tend to be lingually placed, remove them and bring the central incisors back. Remove the lateral incisor if an unerupted canine is entirely labial to it. If teeth have erupted and space is insufficient for the canine then remove the canine. The upper first premolar tooth is the one of most choice. In borderline cases spacing may occur after extraction. Permanent tooth extractions may be necessary due to the early loss of deciduous teeth. Two other ways of
treatment are 1) distal movement of the molars, 2) leave the
crowding. In small arches of Class I cases where a premolar has
to be lost, it is not necessary to maintain space unless it becomes
so small that two teeth need extraction. The less appliance therapy
is used the better.

I would think that Chapman's (53) thoughts on treatment
are definitely asymmetrical. I would not like to have been one
of his victims.

E.A. Cheney (67) deals with four types of arches,
tapering, trapezoid, ovoid and V-shaped. He does not discuss the
hyperboloid or squared arches as they are too rare. In the tapered
arches, extractions are usually necessary. In the V-shaped arch,
extraction can mostly be avoided. The trapezoid and ovoid arches
are borderline cases, and so heredity must be investigated by
parental examination. The relation of the teeth to basal bone
must be checked. Heys Nance measurements and method of timed
extractions is good. If still in doubt treat first and then ex-
tract afterwards if necessary.

In this paper Cheney (67) presents a useful point in
analysis for treatment planning where the question of extraction
is concerned. As a whole, however, the paper could quite readily
have been condensed and still contain the same information.

Extraction procedures are necessary and important treat-
ment techniques in the practice of orthodontics is the opinion of
E.A. Cheney (76). The frequency with which extraction is used
greatly depends on the nature of the results required. The
patient’s requirements are important and any result/which we work should fulfill these requirements. Arbitrary decisions by the orthodontist, without regard to what result the patient wants, should never be made. Extraction is not a short cut or expedient form of treatment since it superimposes additional responsibilities for the management of space. A comprehensive recognition of biology and growth in the dento-facial complex is needed.

Tapering, trapezoid, ovoid, and V-shaped are the four main arch shapes encountered. Hyperboloid and squared arches are rare. In the tapering arch extraction is often necessary, decreasing in necessity to the V-shaped arch in which it is not often required, depending also on other influencing factors. If in doubt then examine the parents. If at least one has a tapering arch with a tendency to crowding, then extract. In the patient a future growth is doubtful. If both parents have more rounded and good arches, then attempt treatment without extractions.

This paper by Cheney (67) on the extraction problem is rather good. Unfortunately Cheney as in the preceding paper which I reviewed is again rather verbose. The paper would have had more force and directness if it had been condensed.

Donald D. Osborn (80) presents a case of Class I malocclusion with spaced upper anteriors and crowded lower anteriors, and with the posteriors normal. Osborn found that the malocclusion was due to a discrepancy in the upper and lower anterior tooth material. He therefore reduced the lower anterior tooth material by removal of the lower left central incisor. The result was both
good and stable.

This is quite an interesting case which apparently was best and successfully treated by an unorthodox treatment plan.

When first bicuspids are extracted, P.D. Lewis (73) inserts a maxillary removable appliance with a bite-plane where necessary, to retract the cuspids and retain the buccal teeth. This is very good for partly erupted cuspids. A lingual arch or preferably a labial arch and coil springs are used on the mandible. The cuspids are guided between the cortical plates for speedier movement. Do not expand the arches. By adjusting the buccal section slightly occlusally to the labial section of the closed loop, depression of the buccal teeth is avoided. The posterior teeth are minimally disturbed by the equality on both sides of the coil spring pressure and by being horizontally directed. All supra-occluding cuspids should be depressed to facilitate movement and prevent relapse. Extra-oral anchorage is used on the lower arch to withstand Class II elastics in the backward movement of the maxillary anteriors and also is used on the maxillary arch when Class III elastics are worn. .016 to .018 to .020 round arches are used first as activators, and to effect rotations and general levelling. .021 x .025 edgewise arches are used to effect the final movements. Retention plates are finally used.

Lewis (73) has presented no new ideas or treatment methods, however, the paper serves well as being good revision.

In a paper previously reviewed C.W. Carey (21) also discusses extractions. He states that all casts should be measured for supporting bone and tooth structure size. No extractions
are usually carried out where there is less than 2.5 mms. discrepancy, but extractions are done where there is more than 2.5 mms. discrepancy. Carey (21) discusses some odd extraction cases. A full history of the patient and parents, models, full mouth and cephalometric X-rays of the patient are necessary. Photographs are useful in deciding whether a change in facial form will improve or mar the profile and general appearance.

Some useful information is presented by Carey (21) on the extraction problem. The unorthodox treatment shown by him in some cases appears to be very successful.

I feel that, with the papers reviewed, the extraction problem has not been very well covered. It is unfortunate that more information and more opinions are not put forward through the Journals.

B.L. Rosenstengel (55) discusses the treatment of protrusion of the upper arch in Class II, Div. I malocclusion. A V-shaped mento-labial sulcus and the lower lip retruded in relation to the chin indicates a retrusion of the lower jaw. However, if the sulcus is shallow, concave, and the lower lip is directly above or slightly forward of the chin, and the upper lip is decidedly protruded, then it is a case of upper protrusion. Simon's "law of the cuspids" is also a diagnostic aid. To correct this condition it is necessary to alter the jaw relationship by distal movement of the upper teeth, or to institute normal breathing and mastication by the removal of a unit on one or both sides of the upper arch, depending whether a sub-division case exists. The latter
course is the better. Remove the first premolar if the protrusion is more than half a tooth, or the second premolar if the protrusion is less than half a tooth. Retract the cuspids and then the incisors. A short arch is used on the upper with intermaxillary traction using a lingual arch on the lower arch or Angle's edgewise arch. Later use a full arch wire on the upper to retract them. If space exists after this treatment, use intermaxillary elastics to move the upper molars forward. At the end of the movement firmly ligate the arch for two months, and then use a Hawley plate continuously for three months, and then at night for three months, except at meal times.

This treatment maintains the posterior teeth in an abnormal occlusion. This maybe a good compromise method from an aesthetic view point, but from a mastication view point the articulation would need to be spot ground to be satisfactory and to avoid traumatic occlusion. I do not favour Rosenstengel's unilateral extraction in sub-division cases, as the centre line may relapse out of alignment.

Bimaxillary protrusion according to D.F. Spring (59) is due to a dysharmony of the tooth to jaw relationship, or due to an early loss of deciduous teeth. In any Class I or Class II bimaxillary protrusion, uncomplicated by the premature loss of the deciduous teeth, the relationship of the molars and incisors must be considered fixed or predetermined. Treatment is all along the same lines, but retention and prognosis is better where the buccal segments are mesially placed due to local factors, than a hereditary case where the incisors must be moved
lingually. In the mixed dentition the regulated extraction therapy of Nance is good, particularly in Class I cases. In the permanent dentition extractions with or without removable appliances or extraction with active orthodontic therapy are the treatment methods. The four first bicuspids are the best teeth to extract depending on the cases. The cuspids are retracted with half arches of square wire with various springs or loops. To retract the incisors double vertical loops on edgewise arches or Class III elastics to retract the lower incisors, and then Class II elastics to extract the upper incisors. .020 round arches are used where the incisors are being moved, and .0215 x .028 arches on the stabilizing arch. To approximate the roots of the second bicuspid and the cuspids, safety pin sectional arches of .021 x .025 wire are used. In Class II cases bring the lower buccal segments forward, but maintain the upper buccal segments and move the anteriors back. Extractions are usually carried out in the mandibular incisor region in Class III cases, but this is dangerous.

When first permanent molar extractions are done, move the upper bicuspids distally using .021 x .025 wire with distal tipping bends and Class II elastics extending to the second bicuspids only. Mandibular alignment is made by the legation of continuous arch wires, or if the malocclusion is excessive, use distal tipping bends and extra-oral anchorage. The mesial movement of the mandibular second molars is effected by Class II elastics.
This is a rather good paper by Spring (59) on the active treatment of bimaxillary protrusion cases. This paper gives one the impression that Spring uses band therapy almost entirely in the majority of his cases. I do feel, however, that in cases due to local factors much can be accomplished with the use of acrylic plates, and then completing the movements with band therapy.

In a paper previously reviewed T.M. Graber (27) advocates the treatment of certain Class II, Div. I cases by extraction in the upper arch only, and the backward movement of the upper anteriors. This maintains the Class II malrelationship posteriorly, but obtains the required aesthetic result.

Karl E. von der Heydt (20) in a paper previously reviewed discusses maxillary protrusion cases as opposed to true Class II, Div. I cases. In these cases his treatments are based on compromise with modified extraction. He sets out a table (Table II) as to what compromise treatment is usually considered for a certain basic type of case. "Compromise" to von der Heydt (20) means only that less than "ideal" or "normal" has been planned or accomplished.

I consider this a very good paper, particularly as I have previously stated, because von der Heydt's (20) approach is flexible. His treatment of maxillary protrusion cases bear much thought. One point of treatment in a few cases that I do not favour is the extraction of an incisor in the lower arch, however, his results may show this to be very successful.

In maxillary protrusion cases it would seem that Rosenstengel (55), Graber (27) and von der Heydt (20) all agree
basically on the treatment of the upper arch by extraction and retraction of the upper incisors and the basic maintenance of the status quo in the lower arch so preserving the Class II relationship. It is amazing that neither author recommends the spot grinding of the occlusion subsequent to such treatment. As his was the only article read on bimaxillary protrusion, there is no comparative comment to make on Spring (59).

Milton M. Lappin (42) states that orthodontic treatment is rarely necessary to cause the impacted canine to erupt. It is only used after eruption to align the tooth. His technique is adequate surgical exposure by an oral surgeon, and then wait three to twelve months. When the tooth erupts, then move it to the correct position. Delayed exfoliation of the deciduous cuspid is the chief causative factor, and is congenital in nature. It is usually lingually placed, and in later life can cause much trouble, so they bear constant watching. Lappin (42) thinks that it is possible that the increased popularity in the use of lateral and antero-posterior cephalometric X-rays will detect impaction in their incipiency. In such a case if the offending tooth is removed early, it may be possible to prevent the impaction of a great many cases. If this method fails, Lappin uses a cast cap to the tooth.

This paper makes the treatment of impacted cuspids sound simple. The technique for various stages which he presents are useful and could possibly be advantageous. It could be worth an experimental trial.
Diagnosis with the aid of X-rays is the first step in the oral surgical treatment of unerupted teeth according to Claude S. La Dow (49). Surrounding anatomical structures, pathological conditions, and the condition and position of the tooth or teeth must be determined. Third molars should be retained till the full growth of the jaws has taken place, even if the chances of eruption are slim. When a third molar is likely to erupt but is held by tissue, such tissue may be well incised to allow the tooth's eruption. In the case of pre-molars, if retained deciduous roots are present remove them, and if space closure has occurred, open it and then excise soft tissue and bone wide around the tooth to permit eruption. Remove over retained deciduous teeth if necessary. In the case of incisors and canines, a careful examination is necessary to determine their position. Remove supernumerary teeth and excise soft tissue and bone to allow eruption. Canines which are likely to prove difficult—particularly horizontal canines—may have a hook cemented into a drilled hole in the crown to aid eruption. The path of eruption of all these teeth may be guided by the way the tissues are excised and the bone is removed.

La Dow (49) has written a rather good paper revealing the aid oral surgery can be to orthodontics in bringing unerupted teeth into aesthetic and functional use.

Writing on impacted teeth K.T. Adamson (51) states that the second deciduous molar is usually ankylosed when impacted, resulting in the other teeth and alveolar tissues growing up round
it. Such a tooth should be removed as soon as possible. Impacted maxillary centrals are due to supernumerary teeth, early injury or trauma, thickened or fibrous gum. Basically treatment is to remove the cause of the impaction. When trauma is the cause, the tooth is often deformed, needing removal. First permanent molars may be impacted beneath the second deciduous molar, in which case a retaining plate is made and the second deciduous molar removed. Such a case is usually a sign of the lack of harmony in tooth and jaw size. Second bicuspid impactions are mostly due to the premature loss of the deciduous teeth; may be due to displacement during development, or due to a rare type of cystic condition. When the tooth is displaced, remove the bone and apply traction maintaining the teeth on each side in position. In cystic cases remove the cyst. Impacted third molars are treated by the removal of the second molars, where there is a lack of space, to allow the third molar to move into the second molar area. This third molar must not be tilted more than 30 degrees from the vertical. If lingually or distally inclined, remove it. Where the maxillary third molars are small and the mandibular third molars are normal, remove them all. Remove these teeth when moving distally first and second molars, which have tilted forward. Adamson (51) has divided impacted bicuspsids into three groups:
Group 1: Canine is labial or lingual to the incisors.
Group 2: Canine is more deep on the lingual with the root distal of normal and the incisal tip is extended level with the mesial of the lateral crown.
Group 3: Canine is completely horizontal on the lingual. The
treatment is exposure of the crown; the more horizontally placed canines may need definite traction, and the third group definitely needs traction. If the crown is too close to the lateral root, sufficient exposure may be unattainable. The rare labially placed very high-up cuspid cannot be brought down due to lip irritation.

This resume by K.T. Adamson (51) of impacted teeth is of much use to the orthodontist, and particularly to the dentist and oral surgeon, as it shows them that many impacted teeth can be brought into the arch instead of being removed.

S.V. Mead (65) states that impactions seem to have increased with the decrease in masticatory function, along with a decrease in the size of the lower jaw and skull, due to less force being exerted on the muscle attachments. Endocrine disorders, hereditary factors, nutritional disturbances, rickets and other pathological conditions must be considered. Sometimes it is better to leave the impaction undisturbed. It may need to be removed for orthodontic or other reasons, or may be retained and exposed to allow eruption, or to replace another tooth to be extracted. Third molars are the most commonly impacted teeth, followed by canines and then bicuspids. The third molars are blamed by some for crowded anteriors, but usually the anteriors are crowded before the third molars are impacted. X-ray examination is always necessary, and sometimes consultation between the dentist, oral surgeon, orthodontist and physician is necessary.

This is a very good paper which should be read, particularly by every dentist and oral surgeon. It would make
them realise the folly of extracting all impacted teeth as is quite often the case.

The four papers reviewed on impacted teeth are, I feel, of a generally high standard. They give, particularly as a small group, a good cross-section of ideas and thoughts on the problems and management of impacted teeth.

In the surgical treatment of protrusion of the mandible, S. Scougal and G. Colvin (58) perform osteotomy in the body of the mandible. The amount of bone removed is, according to orthodontic requirements, and the remaining sections are positioned accordingly. Nerve regeneration is very good. With the great aid of chemotherapy no case of sepsis has been experienced. The posterior transsection is done first for the control of haemostasis. A Kirschner wire is used for fixation, with intra-oral fixation usually unnecessary. The wound is closed in layers and temporary compression dressings are used, which are removed in three days, and then portex or plastic skin is used. The sutures are removed on the seventh day, and the end result is an almost invisible scar, as the incision is in the skin fold beneath the lower border of the mandible.

The only really successful method of treatment for a Class III malocclusion is surgical intervention. The above operation would seem to be one of the best surgical methods.

G.V. Barrow and R.O. Dingman (74) state that those cases which are too extreme for orthodontic treatment alone, may be surgically treated. The cases are, 1) mandibular prognathism, 2) mandibular deficiency, 3) non-habit open-bite, 4) lateral man-
dibular displacement, 5) various combinations of these.

To determine the size and shape of the removable bone segments, it is advisable to mount accurate orthodontic models on an articulator. A framework is constructed for the mandibular model so that its parts can be returned to their original relationship with the maxillary model after sectioning. The mandibular segments are shifted into the most ideal relationship with the maxillary teeth. This shifting usually needs some removal of occlusal interference by trimming, extraction or movement of teeth. In the correction of extreme retrusion cases it is important to make horizontal cuts parallel to the occlusal plane if no change in the depth of bite is desired.

When posterior areas of the mandible are edentulous, the posterior segments of the mandibular model are lined up with the anterior segment so that the crest of the ridge is continuous. When the anterior area is edentulous, the mandibular anterior segment is positioned so that its ridge is in the same vertical plane as the ridge of the anterior maxillary arch. The appliances are made of precious metal as it is easier to handle, and is very strong. To make cementing less difficult, the upper and the lower appliances are made in sections. The mandibular posterior segments are stabilised by soldering occlusal extensions to the maxillary and/or mandibular molar bands. Removable acrylic splints are used when there is an unstable occlusal relationship of the mandibular segments with the maxillary teeth, and also when it is desirable to maintain a space between the mandibular teeth or ridge and the maxillary teeth or ridge. Close co-ordination between the orthodontist
and surgeon is essential.

This is a most interesting and enlightening paper on this phase of orthodontic problems and treatment.

These two papers on the surgical treatment of extreme cases, particularly the latter paper, certainly present something very concrete in their treatment. I believe it is more and more realized that surgical treatment can be of much aid to the orthodontist. I feel that a very large percentage or orthodontic treatment will be, if not already, a matter of close cooperation between the orthodontist, oral surgeon, and general surgeon.

When the bite is opened in closed bite cases, Paul D. Lewis (36) states that it is achieved by the further eruption of the molars and premolars, with very little, if any, depression of the incisors taking place. This is mainly achieved by the use of a bite plate, mostly in cases of deep over-bite, posterior mandibular displacement, lateral mandibular displacement, bilateral and anterior cross-bites, and difficulty in banding certain mandibular teeth because of occlusion with the maxillary teeth. The bite plate is particularly useful in extraction cases which are complicated by a closed bite. The bicuspids readily move distally with springs attached to the plate. The flat plane is preferred, as it is found that the inclined plane causes labial inclination of the mandibular incisors instead of moving the mandible forward in Class II cases. The exception is Class II, Div. II cases where lingually inclined incisors are brought more upright or inclined labially by the inclined plane.
Lewis (36) makes a fair appraisal of the use of the acrylic bite plate in opening the bite and in extraction cases. However, Lewis (36) discusses extraction cases where the first premolars only are extracted, but the plate is also very useful when second premolars and first molars are extracted.

Saul M. Bien (37) shows and compares the degree of resultant force obtained when intermaxillary elastics and the headgear are used. Distal movement of the upper buccal teeth is the movement used for the analysis. With intermaxillary elastics, the only useful force is the distal driving component, which when the mouth is closed and when it is open, is 2.5% and 25% respectively, less than the original force applied by the elastic. Also quite large undesirable forces are applied to the teeth, that is a mesial force on the lower molars, rotational force on the lower molar root ends, and an occlusal force on the lower molars. There are also occlusal and rotational forces on the upper molars. With a headgear with a spring traction bar, the desirable force, that of distal force on the upper buccal teeth, is the same as the original force, and the only undesirable force is that of rotation of the upper molars, and this is considerably less than if this force were applied by intermaxillary elastics.

It is quite obvious that, from the point of view of mechanical efficiency, the headgear with a spring traction bar applies the most efficient force for the distal movement of the teeth. However, intermaxillary elastics, if correctly used, can obtain good results, and are superior psychologically during the day. I feel that a good technique would be the use of elastics
during the day, and of the headgear at night, particularly in the more difficult cases.

Blair C. Madsen (40) is a periodontist who has apparently treated several cases of periodontoclasia, the alleged cause being traumatic occlusion following orthodontic treatment. He illustrates with one particular case the results of such an occlusion. There is premature contact in centric which resulted in shifting of the mandible and excess temporo-mandibular pressure and abnormal pressure on the other teeth. The patient had "a lack of normal gingival tonicity" and "complained of general sensitivity to pressure during mastication". There were "symptoms of tenderness suppuration, and evident bone loss", which improved with grinding. This is done with carbon paper and grinding the inclined planes to make them more horizontal so that interference is removed and the bite is not closed.

Rather dramatically Madsen (40) shows what can happen following orthodontic treatment to the periodontal tissue, if the occlusion is not checked and interferences are not removed. The orthodontist is reminded that not only must the health of the periodontal tissue be considered during treatment, but also after treatment.

With an increased life expectancy, the teeth should be retained longer, hence the greater necessity for orthodontic and periodontic treatment according to J.T. Rothner (50). After orthodontic treatment the dentition should be ground in, thus eliminating possible traumatic occlusion. Make sure correct contact points and occlusal contact exist. Flat surfaces should
be rounded. The teeth should be in their correct plane. Proper
restorations and prosthetic appliances should be inserted. Teeth
with short roots are a poor orthodontic risk. Rothmer (50) gives
his method of grinding in. With occlusal correction the retention
period is decreased and periodontal troubles are prevented.

This paper contains much which would profit most ortho-
dontists. The benefits resulting from such attention should be
well worth the extra effort.

J.J. Dolce (69) states that, as shown by Waugh, in his
eskimo experiments, carbohydrates are the definite cause of caries.
Flourides and ammoniated dentifrices are deterrents to caries. The
presence of a foreign object, whether orthodontic appliances or
otherwise, can increase caries susceptibility. Appliances must be
simply designed, and the bands must be well-fitted and cemented and
should be easily cleansed. The patient's oral hygiene is important.
General cleansing should be done at each visit of the patient. The
appliances are removed and a check for caries is done every six
months.

The setting of cements etch the enamel, but once set they
are non-effective. There is a protective film which is removed by
setting or grinding. The use of collodion prevents etching. The
washing away of cement must be checked.

In the test, Johnson's twin-wire appliance, S.S.W. Germi-
cidal Kryptex for molar bands and Stratford-Cookson Zinc Oxyphos-
phate cement for anterior bands were used. The patients were seen
every three weeks when the arches were removed, prophylaxis was
done and bands were checked. The results were that there was no appreciable increase in caries incidence where the above method was carried out. Much of the caries occurred in the unbanded bicuspid and on the occlusal of the second molars. Hence, if care is taken there need be no fear of orthodontic appliances causing an increase in caries incidence.

This is a very timely article by Dolce (69), which I feel could profitably be read by all members of the dental profession, and so remove a false impression of the terrors of orthodontic appliances.

With growth, the temporary dentition should space, according to A.A. Battiste (61), however, growth may be gradual or spasmodic. Appliances may be used to stimulate growth and create room for the permanent teeth. Cross-bite, Class II and Class III cases should be treated in the deciduous dentition. The permanent tooth ends follow the deciduous roots, so use appliances to obtain bodily movement. Baker and Salzman favour mixed dentition treatment. Lewis says that care should be exercised to not to mistake the normal for the abnormal at this period. Nance treats extreme cases at this time. Denham says that permanent dentition treatment is still necessary. Kloen believes that failure in treatment at this period in Class II Div. I cases is due to bad anchorage. Ebey treats immediately following the eruption of the permanent teeth, while Case and Helman wait till the 12 year molars erupt. Brodie, Thompson and Nance generally believe in waiting.

The general opinion is that only extreme Class II, Class III and cross-bite cases should be treated in the mixed dentition.
In the primary dentition only those cases where normal development and occlusion are hindered are treated. Most treatment is carried out in the permanent dentition after the second molars erupt.

This is rather a useful paper on this vexed question, giving one a general idea and lead as to when to commence treatment.

The main factor in obtaining success in orthodontic treatment, according to R.H.W. Strang (78) is to follow the Tweed philosophy in placing or maintaining all teeth over the basal bone. Ancillary to this is that there must be no expansion in the canine area. Canines may be moved buccally if they are moved distally into the first premolar space when these are extracted. Following this rule will result in more extraction cases, but will result in greater stability. Other factors are: 1) the elimination of the etiologic factors. This is sometimes impossible. 2) place the teeth so that they will have substantial basal support - Tweed philosophy. 3) Obtain correct inclined plane adjustment. Occasionally the sacrifice of teeth in one denture only defeats this rule, but it may be necessary for stability. 4) Establish the normal axial position of each tooth or a position to resist any relapse tendency. 5) Obtain correct proximal contact. It is better to over-rotate a tooth as they tend to slip back a little. 6) Secure over-correction of an excessive over-bite. Cases in which the vertical growth in the oral area of the face is distinctly lacking often relapse to an over-bite. 7) Obtain balance and harmony in the activating and environmental tissues. Elimination of habits and hypotonicity is necessary. Hypertonicity cannot be eliminated; in such cases extract to relieve the crowding as a relapse will occur if the in-
cisors are moved labially. 8) Finally resort to occlusal equilibration. Supra-occluding canines are the greatest offenders. Occlusion in lateral and protrusive movements must be checked as well as in centric. After the dentition has settled it should be ground in.

Strang (78) has presented quite a good paper on the main factors in obtaining successful treatment. However, I feel that some of his treatments appear to be a little radical.

The variety of material covered, which deals with treatment, reveals the wide range of treatment methods advocated. Some methods which are new appear to be worth trial, but others, I feel, are comparatively useless. The evidence bears much sifting.

This review covers quite a variety of material and reveals a wide range of opinions. After reading the articles and other matter for this thesis, one realizes the importance of maintaining an open mind. I believe that when one becomes narrow and set in one's ideas, progress ceases, and then one may be more readily baffled by the not so easy cases which often arise, needing a different train of thought.

FINIS
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"CLASS II, DIVISION I, MALOCCLUSION"

by Rex E. Fortescue, B.D.S.
"CLASS II, DIVISION I, MALOCCLUSION"

This is a review of some papers written in recent years on this controversial section of orthodontics. It would appear that there is more diversity of opinion on this section of orthodontics than on any other section.

The results of a scrutiny of the research which has been carried out on Class II malocclusions are presented by G.V. Fisk, M.R. Culbert, R.M. Grainger, B. Hemrend, and R. Moyers (1). In Class II Division I malocclusion they list six possible morphologic variations. Comparing Class II Division I and Class I malocclusions, investigators varied on the relation of the maxilla to the cranium. Most investigators stated that the maxilla was longer in Class II Division I cases, while a majority stated that the relation of the teeth to the maxilla was the same as Class I. A majority found that the mandible was shorter, while the indication on Ramus height is only that it may be shorter in these cases. There appears to be no difference in the gonial angle, while the mandible would definitely appear to be in distal relation to the cranium.

The distal relation of the mandible to the cranium is either structural or functional. Functionally it may be caused by acquired muscle contraction patterns, as a result of tooth interferences, or a sucking habit, or by some muscle contraction patterns which may be congenital in origin.
(Although not relevant under the title of this thesis, but useful from a comparison point of view, the authors (1) indicate that Class II Division II malocclusion is due to mesially placed maxillary teeth with a normally placed normal mandible.)

This is a most important paper on disocclusion. There have been so many conflicting conclusions by investigators as to the prevailing conditions of Class II Division I malocclusion, that it has become most confusing. I do think that this paper should clear much clouded thought.

Using an Offner Type A six-channel electro-encephalograph, R.E. Moyers (2) obtains tracings caused by the spike potential of the contracting muscles in Class II Division I cases. The muscles tested were the Temporal, Masseter, Internal and External Pterygoid, Suprahyoid, and Mental Muscles. It was found that the Temporal Muscle was the easiest from which to obtain data. The cases fell roughly into four groups.

Group I - Total mandibular retroversion only. - The Temporal Muscle was the only one to show abnormal patterns, and this was in the most posterior fibres, when the mandible is in physiologic rest position. During strong isometric contractions with the teeth in occlusion there is a greater rise in frequency in the posterior temporal muscle fibres. There was no hypertrophy of the Mental Muscle.

Group II - Mandibular retroversion with maxillary anteversion, or with dental maxillary anteversion. - Here, during all mandibular movements, the posterior temporal fibres
exhibited greater spike potentials than the remainder of the muscle. There was marked overbite in these cases, and most displayed a marked hypertrophy of the Mental Muscle.

Group III - Total maxillary anteversion. - The most anterior fibres of the Temporal Muscle gave slight spike at the initiation of mandibular depression. The domination of the mandibular elevator over the depressor muscle was evident. There was extreme overbite and mental muscle hypertrophy.

Group IV - Dental Maxillary Anteversion. - Almost normal muscular pictures. The Mental Muscle was hypertrophied, there was anterior open bite and also a history of thumbsucking and/or tongue thrust habit.

In Group I tooth interference is probably the cause with the muscular dysfunction a result. In Group II there was no apparent muscular change except an apparent decrease in the size of the Mental Muscle. It would seem that the mandible in being carried forward, results in the stretching of the muscle fibres previously giving the greatest spike.

In Group III treatment caused a muscular imbalance of the Temporal Muscle due to the mandible being moved forward. The chance of a normal muscular picture in Group IV after therapy appears to depend upon the amount of forward drifting of the maxillary teeth.

It will be of much benefit when we know the full story of the muscular association in Class II Division I cases, and indeed in all orthodontic cases. This work by Moyers (2) is a
great commencement and will no doubt stress to orthodontists the importance of the musculature to treatment plans as has been shown already by Rogers.

Only that part of this paper by J.R. Thompson (3), dealing with Class II malocclusion, is reviewed here. "Wylie, Elsasser, and Brodie have expressed similar views that malocclusion, and particularly Class II (Angle), is the result of a combination of disproportionate facial and cranial parts."

That oral and environmental factors alone may bring about a Class II relationship of the mandible and maxilla in an otherwise normally growing organism is still an unsettled question. "Functional analysis of occlusion is based on the concept that the position of the mandible is established fundamentally by the musculature." "This position, called rest position of the mandible, cannot be overlooked in the analysis and correction of malocclusion." "The two important phases of functional analysis are the size of the intermaxillary clearance or 'freeway space' when the mandible is at rest position and the path of closure of the mandible from rest position to occlusion of the teeth."

Normal closure is upward and forward with the hinge practically in the condyle head. In Class II Division I cases in which the rest position of the mandible is Class II and has a normal path of closure, there is no hope of repositioning the mandible anteriorly. This is a true Class II case. The other Class II cases show a Class I or partial Class I rest position, and an abnormal posterior path of closure, which is probably
due to local factors. "The entire concept of the changes that supposedly occur in tempo-mandibular articulation as a result of orthodontic therapy, must be reconsidered in the light of these findings concerning the position of the mandible. In those cases where the mandibular position does alter, the rest position of the mandible is not altered, but the path of closure is changed from an abnormal upward and backward path to the normal, by eliminating the points of occlusal interference."

A combination of local and genetic factors in etiology must always be a considered possibility.

This is a most enlightening paper, particularly on the question of the repositioning of the mandible in the treatment of Class II Division I malocclusion. It would seem that Thompson (3) has cast a serious reflection on previously popular ideas on Class II Division I treatment results.

It is shown by Karl E. Von der Heydt (4) that many Class II Division I cases are really maxillary protrusion cases. These are divided mainly into True Maxillary Protrusion with Normal Mandible; Potential Maxillary Protrusion with Normal Mandible, and Maxillary Protrusion with Mandibular Insufficiency; the latter being a borderline group. The treatment for maxillary protrusion is suggested as the extraction of the two upper first premolars, or other teeth depending on the conditions and the maintenance of the lower arch intact. Von der Heydt (4) also states that full extraction procedures should be reserved for true and potential Bimaxillary Protrusion, and that no extractions
should be planned for cases of mandibular displacement, or a retruded dental arch. He also hints that it would be better to use extra-oral anchorage in these cases so as to cause no forward movement of the lower teeth.

This is a very good article on these cases. Von der Heydt[4] shows further the trend of thought to-day on Class II Division I cases. I feel that his approach is refreshing as it is done with a more open mind than is often found to-day.

B.T. Swain[5] states that there are two characteristics of Class II Division I malocclusion: 1) Upper anteriors are in labial-axial inclination, and 2) occlusion of some or all of the teeth of the buccal segments in Class II relation. In treatment there should be no expansion of the denture, increase of vertical dimension, or change in jaw relationship. "We must maintain the arch form, length and thickness, and the vertical and horizontal relationship of the arches."

In treatment the hypothesis is to maintain the status quo of jaw relationship, vertical height, arch length, and muscular balance. In most cases extraction is carried out, and the upper incisors are moved lingually and the lower buccal segments moved mesially. As first strongly suggested by Tweed and clinically proven, the best results are usually obtained by extraction of the four first bicuspids. However, owing to the condition of teeth due to caries, other teeth very often must be extracted, particularly first molars. Congenitally missing teeth sometimes present problems, as also assymetry between teeth in opposite sides of the same arch and discrepancy between teeth in
each arch, particularly anteriors. Teeth previously of
necessity extracted often present problems.

The extraction of like teeth is always practised where
possible, but it is sometimes necessary to extract unlike teeth,
where some of the above conditions are present. Grinding or
reshaping of anteriors is sometimes justified. Occlusal equi-
libration is suggested after treatment.

This paper by Swain (5) causes much thought on Class II
Division I treatment. The case for this way of treatment appears
strong, but much comparison with usual treatment methods is needed.

A typical Class II Division I case report is presented by
William F. Ford (6). The cephalometric analysis (Downs and
Riedel method) revealed a good skeletal pattern, but a protrusion
of the upper incisor teeth of 10.54 mm. to the N.P. Plane and a
tipping of these teeth of 128.5° to the S.N. Plane. The axial
inclination of the upper to lower central incisors was 102.1°,
and the inclination of the lower central incisors to the man-
dibular plane was 99.2°. There was a normal path of closure.
Prognosis was favourable, and heredity was the etiology.

The four first molars and four upper incisors were
banded. A twin-wire was inserted passively, and then three
weeks later a lower Mershon appliance and a new upper twin arch
with intermaxillary hooks were set. The patient was seen at
three week intervals. 3 oz. elastics and no stops on the arch
wire were used to retract the upper incisors. Then coil
springs \( \frac{3}{8}'' \times .009'' \) were inserted and 5 oz. elastics used. After
six months, the molar relationship was satisfactory, and the coil springs were removed. The arch was pinched in front of the buccal tubes, and elastics worn daytime only until the pre-molars erupted into proper position. Elastics were worn then for three hours a day for 4½ months, then Hawley retainers were used. The results were good, with a good profile, and cephalometric measurements within the normal range.

Ford (6) has shown a good result with the use of the twin-wire appliance. It is rather a good paper on a Class II Division I treatment, which incidentally reveals the value of the appliance used.

Another case report, that of a boy aged 12 years, is presented by William F. Ford (7). The case was a typical Class II Division I, with a pronounced maxillary dental arch protrusion, and both a functional and structural slight retraction of the mandibular dental arch. The patient was also a mouth-breather, and the etiology was hereditary.

All four first molars, the maxillary incisors, and the mandibular six anteriors, were banded, and Johnson twin-wires were inserted. When the upper anteriors were in good alignment, new twin-wires with intermaxillary hooks were inserted and Class II elastics started. The protrusion was reduced after four months, and then .009" x 3/8" coil springs were inserted to move the upper buccal segments distally. The lower spaces were closed with a pull type coil spring. This phase lasted eight months. As the bicuspid at this time had not
fully settled, the appliances were worn for a further twelve months with the upper end section stopped in front of the molar tubes, and elastics worn for eight hours a day. The appliances were removed, and retainers worn at night. The result was good occlusion and facial harmony.

Cephalometric tracings showed that the upper buccal segments were restrained during growth, while the remainder of the facial components moved downwards and forwards.

Ford\(^{(7)}\) obtained a very pleasing result in this case. Of much interest was the co-operation between growth and treatment. As stated by Ford\(^{(7)}\), a few years later the treatment would have necessitated the extraction of two maxillary premolars.

According to Beulah G. Nelson \(^{(8)}\), the use of extra-oral anchorage was revived by Albin Oppenheim in the 1930's. "The value and wide range of possibilities offered by this simple method of exerting gentle intermittent force from extra-oral anchorage was not immediately recognised." A very light force is all that is necessary.

No treatment is given to the lower arch except a lower lingual appliance during the change over from deciduous molars to permanent premolars, or an aligning arch. A headgear or cervical strap is used, and the archwire attached to the facial bow is of .045" stainless steel. The upper molars are moved distally first, and then, using the extra-oral anchorage as a maintaining force, intra-maxillary latex elastics are used to retract the bicuspid and cuspids.
Inter-maxillary elastics are not used at all. It would seem also that no plate is used in conjunction with the extra-oral anchorage.

The results are obtained by restricting the mesial movement of the maxillary teeth during growth, or by actual maxillary distal movement.

This treatment of Class II Division I cases using extra-oral anchorage as advocated by Nelson (8) is most interesting. More stress seems to be placed on the maxillary arch.

An edgewise appliance and cervical strap is used by J.R. Jarabak(9) in treating Class II Division I cases. With a full complement of permanent teeth, bracket bands are placed on the maxillary central and lateral incisors and first premolars. Where the first premolars are extracted, the second premolars and canines are banded. In the mixed dentition, the first deciduous molars are banded as well as the incisors. In all cases the first molars are banded with .022 x 028 buccal tubes attached. A bite plane is used in all cases where the lower anterior teeth occlude on the palatal rugae.

The arch-wire is made from stainless steel wire, four to four and one half inches long, and .022 inch diameter. Two vertical loops 5/8" long are bent into the arch distal to the canine teeth. If there are spaces between the upper anterior teeth, no stops are placed mesial to the molar tubes. The cervical strap is made from an elastic pyjama belting material 18" long and 1 1/2" wide. This is folded upon itself and sewn.
together at the free ends. Two pieces of wire, 6" long and .054" diameter, are used to attach the strap to the arch. Two loops \( \frac{3}{8} " \) in diameter, one inch apart, are placed at one end of the wires, and then they are sewn to the strap. A small loop \( \frac{3}{8} " \) in diameter is placed at the free end of the wires for attachment to the vertical loops of the arch-wire. The wire is bent so as not to irritate the corners of the mouth.

Five various types of cases are shown to illustrate the appliance's uses. However, this method of treatment is not successful in cases where the bony bases are poorly related to each other. Jarabak (9) makes use of what he calls the reflex phenomenon. This acts when sufficient pressure is applied to the upper anterior teeth, causing the mandible to move upward and forward.

Jarabak (9) has presented a paper which is most interesting, on the use of extra-oral anchorage. The value of this type of anchorage seems to be more and more realised.

A case which had a narrow pointed maxillary arch with a retrusive underdeveloped mandible is presented by James C. Brousseau (10). The six year molars had drifted mesially, and the mandibular central incisors were congenitally missing. Etiology was due to a general arrest in bony growth, a history of thumb-sucking, and a tendency to Class II on the maternal side.

Four molar bands were cemented, and chrome metal .036 maxillary labial, and mandibular labial, and lingual appliances were used with Class II elastics. About 4 months later an
upper twin arch was inserted. Due to the lack of conscientious wearing of the elastics, and frequent breakage of the twin-wire, progress was slow. Therefore an occlusal guide plane, as advocated by Dr. Oren Oliver, was substituted. This was successful and was replaced by an acrylic retainer. About nine months later a new occlusal guide plane was inserted due to slippage on the right side. Seven months later a Kesling positioner was used for one and a half months. A nobilium casting, replacing the two mandibular central incisors, was inserted in the lower arch.

During treatment, the general growth was excellent, and the author attributes all the results of this case to the remarkable growth during this period.

Brousseau (10) has shown a most interesting case. The degree of growth during the treatment period was indeed remarkable; however, due credit must be given to Brousseau (10) for obtaining a good result in most difficult circumstances.

The case report of a girl, 11 2 years old, is presented by Edward A. Lusterman (11). It was a Class II Division I case with mesial drift of the maxillary buccal segments and severe protraction of the anterior segments, creating a double protraction. The mandibular left second molar was congenitally missing, and the right second premolar was impacted horizontally. The lower deciduous second molars were still in situ. "Since there was no premature loss of deciduous teeth, and no history of deleterious habits, we may assume that the deformity was due to
a morphogenetic pattern, aided possibly to some degree by mouth-breathing."

The mandibular second deciduous molars and the impacted second premolars and maxillary first premolars were extracted. Edgewise sectional arch-wires .021 x .025 were used to retract the maxillary canines and mandibular first premolars and canines. Auxilliary extra-oral anchorage was used on the maxillary buccal teeth. The lower anterior teeth were then banded and successive .018 and .020 round wires were placed to correct rotations, and level off the occlusion. Then a .021 x .025 arch-wire with vertical loops carried the lower first molars and then second molars mesially. .018 and .020 round wires with the maxillary anterior teeth banded, corrected rotations and levelled the occlusion. The maxillary extra-oral traction was now discontinued, and a .021 x .025 arch-wire with Class II intermaxillary hooks was inserted, and the maxillary canines further retracted by light pull coil springs. Elastics were worn for nine months, then a .020 round wire with pot-belly loops was placed in the maxillary arch to condense the anterior teeth. A month later the mandibular anterior bands were removed, and .021 and .025 sectional arch-wires were used with rubber dam elastics to close up anterior spaces. All bands were then removed from the mandibular teeth, and an acrylic splint made for the mandibular arch to provide stationary anchorage for further retraction of the maxillary canines. The mandibular first molars were re-banded with hooks for elastics. .021 x .025 sectional wires were placed on the maxillary buccal
teeth, and the canines retracted. Intermaxillary elastics were used for four months until the buccal occlusion was corrected. Two years and seven months after treatment commenced, all appliances were removed. Upper and lower Hawley retainers were inserted, but the mandibular retainer was discarded after being lost a month later.

Both aesthetically and functionally, the treatment was successful.

I do feel that probably with better planned use of his extra-oral anchorage, Lusterman (11) would have had less difficulty with the maxillary arch, and the treatment time would have been reduced.

Theodore J. Jerrold (12) presents the case report of a girl aged 11 years 3 months. The case was a Class II Division I (Angle) malocclusion. The maxillary arch was also in protraction. X-ray examination revealed the presence of all unerupted permanent teeth.

The patient was a thumb-sucker until six years of age, which undoubtedly caused the maxillary protraction. The premature loss of the mandibular deciduous lateral incisors was the probable cause of the mesial movement of the mandibular buccal segments.

A Mershon lingual appliance was fitted to the maxillary arch, and the first premolars and deciduous canines were removed. After the eruption of the maxillary canines, the lower first premolars were removed, and .021 x .025 sectional arches were fitted to both the upper and lower buccal segments. The arches
had vertical closed spring loops in them, and stops were placed 
\( \frac{1}{8} \)" mesial to the molar tubes so that the loops could be ac-
tivated every three weeks. When the spaces had closed, the
anterior teeth were banded, and a .018", followed six weeks
later by a .022" stainless steel wire, was used. Then .021 x
.025 arch wires with vertical spring loops and the anterior seg-
ments rounded were used. They had distal tip-back bends in
the buccal segments, stops \( \frac{1}{8} \)" mesial to the molar tubes for the
closure of the spaces. Then a .021 x .025 arch wire with
distal tip-back bends in the buccal segments, and co-ordinated
mass lingual torque in the anterior segment, and stops against
the buccal tubes and intermaxillary hooks, were placed in the
mandibular arch. In the maxillary arch a .022 x .028 wire,
similar to the mandibular arch, was inserted for the reception
of occipital anchorage. Class III elastics were applied.
These arches were then replaced by similar arches of .021 x .025
in the maxilla and .022 x .028 in the mandible for Class II
elastics, in order to bring the mandible forward. At the end
of treatment a positioner was used for two months, no other
retention being used.

The total time of treatment was 29 months. The results
were good, and it was noticed that almost two years after treat-
ment had finished, there was considerable facial improvement.

The result obtained in this case was very nice. How-
ever, I feel that the frequent changing of the appliance was
unnecessary if a simpler appliance design and plan has been used,
plus the fact that the same result would have been achieved.
Although attempted, I would very much doubt that Jerrold\textsuperscript{(12)} repositioned the mandible forward. A before and after cephalometric analysis would reveal what really took place.

Another case report is presented by Theodore J. Jerrold\textsuperscript{(13)}, that of a girl 13 years 9 months. She had a Class II Division I malocclusion with an entire protraction of the maxillary arch. The mandible was retracted with the anterior teeth in protraction, although well formed with only a mild Curve of Spee. The patient had a tongue-thrusting habit, which resulted in the small Curve of Spee, and also an anterior open bite. Mouth-breathing and tongue-thrusting habits were responsible for the open bite anteriorly, and for the maxillary protraction.

Four first premolars were extracted, and bands were fitted to the maxillary and mandibular canines, second premolars, and first and second molars. .023 x .029 tubes were attached to the second molar bands. .021 x .025 sectional arches were fitted, having spring loops incorporated, and stops \( \frac{1}{2} \)" mesial to the molar tubes, so that the spring loops could be activated every three weeks. After the canines were brought back, bands were fitted to the anterior teeth. .018" followed by .022" round wires with stops against the molar tubes levelled off the teeth. .021 x .025 arch-wires with vertical closed spring loops and the anterior segments rounded, closed the anterior spaces and brought the anterior teeth lingually. Distal tip-back bends and stops \( \frac{1}{2} \)" mesial to the buccal tubes to activate the loops were also incorporated. Anchorage was prepared as taught by the Tweed Philosophy. The maxillary arch received a
.021 x .025 wire with hooks for Class II elastics, and the mandibular arch a .022 x .028 wire. No. 2 intermaxillary elastics were employed to establish normal jaw relationship by bringing the lower jaw forward. After twenty-six months of active treatment, the appliances were removed. A positioner was then inserted and worn for two months.

The results achieved seem to be very good. However, I feel that the same result could be achieved by a less complicated treatment plan. I would think that, in the light of recent literature, Jerrold's (13) statement (as in his previously reviewed case report (12), that he brought the mandible forward, is somewhat incorrect.

Various methods of treating Class II Division I malocclusion have been shown in this thesis. All methods appear to obtain good results, and although I think that some treatment plans are complicated, the men who use them achieve their which is objective of most importance.

The most important development in the treatment of Class II Division I cases is the recent changing of ideas concerning the possible repositioning of the mandible. It would seem that where the mandible itself is distally positioned, it cannot be brought mesially into a new permanent forward position. Where the mandible is normally positioned in rest position, but moves upward and distally into a Class II relation on closure, then this abnormal closure path can be corrected to give a normal jaw relationship on closure.
It would also seem that a greater percentage of cases than previously realised, are not true Class II Division I cases, but are Class I cases with maxillary protraction, giving the appearance of a Class II Division I case.

The facts mentioned above are of great importance, and the type of Class II Division I case must be determined if the best treatment is to be applied, and the best results obtained.

FINIS
BIBLIOGRAPHY


