History of Articulators: Henry L. "Harry" Page and the Transograph

Robert L. Engelmeier, DMD, MS[1] and Edgar N. Starcke, DDS[2]

The intention of this article is to introduce the reader to the Transograph from a historical perspective. The technical data presented are intended to help the reader understand the design of this unique instrument and how it was programmed, but will not provide the reader a thorough understanding of this philosophy. The article seeks neither to defend nor criticize the principles of Transographics.

INDEX WORDS: transograph, transographics, Harry Page, gnathology, articulator

TRANSOGRAPHICS was a philosophy of articulation essentially based on gnathological principles, but which made a bold departure in the practical application of those principles. In his writings, Harry Page[1] recognized the Gnathological Society of California for advancing sound principles of jaw function as early as 1926. He argued, however, that the application of those principles, along with the necessary instrumentation, had become so complicated that much confusion and indifference toward the Gnathological Society's work had resulted. Page claimed, "The development of Transographics was an effort to apply the original Gnathological principles with more direct and efficient methods thereby yielding superior results."[1] He passionately believed that articulation and the "duplication" of mandibular movement were engineering problems solvable by existing technology. His theory of Transographics stood on two basic principles. First was his conviction that the "first point of contact" upon closure in any individual mouth was always precisely the same. Second was his belief that only the last few millimeters of final closure were important in assuring an accurate cusp to fossa occlusion.[2]

[1]Director, Graduate Prosthodontic Program, Department of Prosthodontics, University of Texas, Houston, TX.

[2]Clinical Professor, Department of Prosthodontics, University of Texas, Houston, TX.

Correspondence to: Edgar N. Starcke, University of Texas Health Science Center – Houston Dental Branch, 6516 M.D. Anderson Blvd., Houston, TX 77030. E-mail: edgar.n.starcke@uth.tmc.edu

1059-941X/06

doi: 10.1111/j.1532-849X.2006.00128.x

Page's enthusiasm for the Transograph articulator was matched only by his denunciation of most other instruments of the time. His criticism focused on what he believed were their three greatest design flaws:

1. Ball and socket condylar controls,
2. A solid intercondylar axis, and
3. Non-arcon design.

The theory of Transographics was based upon four basic determinants—Page's four major principles of "Functional Articulation:"[1]

1. The Temporomandibular Joint Center of Rotation (i.e., The Hinge Axis),
2. The Cranial Reference Plane (i.e., The Axis Orbital Plane),
3. Collateral Bodily Shift of the Mandible in Function (i.e., The Bennett Movement), and
4. The Envelope of Motion.

Because he believed static jaw positions could not define function,[3] Page sought to record the four determinants, use them to program the Transograph, and "accurately duplicate a patient's functional jaw movements." The Kinetic Principles, which Page believed governed mandibular movement, dismissed static jaw relation records, which historically had been used to articulate casts and program dental articulators, e.g., Centric Relation, Protrusive, and Lateral Records. The Transograph (Fig 1)[4,5] was programmed either by means of a pantographic tracing or a series of positional records which defined the arc of movement around each of the three axes (passing through each rotation center). Page claimed that the force

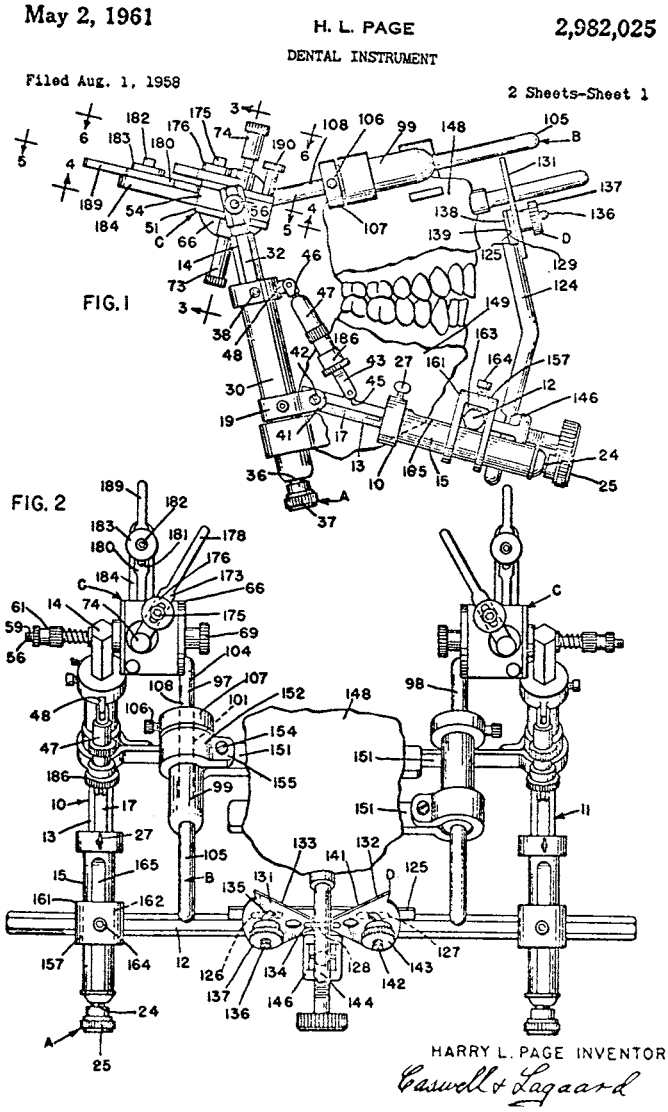

Fig. 96 Harry L. Page of Valparaiso, Ind. Patent #2,982,025 May 1961. Spring devices incorporated in housing C as shown in Fig. 2 allow for a "broken axis" effect and still maintain centric position.

Figure 1. The U.S. Patent Office awarded the Transograph Patent #2,982,025 in 1961, along with the trademark "Jaw Recorder and Duplicator." The theory of Transographics, in principle, actually promoted very few new ideas; however, the instrument and how it applied these concepts was an entirely new and controversial departure.[22]

and direction of jaw movement were under the control of "Kinesthetic Proprioceptors," found in the muscles, ligaments, and joints.[3]

Principles of "Functional Articulation"

The Temporomandibular Joint Center of Rotation

In his writings, Page[1,3,6-13] argued that each temporomandibular joint had its own horizontal axis of rotation. He theorized that these individual axes did not line up with each other because of asymmetries in joint anatomy and location of the joints on either side of the head. He insisted that the condyles could shift (in any direction) to compensate for these discrepancies. He liked to compare the joints with self-aligning bearings. Even though the design of nearly all articulators developed over the previous century had been based on the existence of a Transverse Horizontal Axis, Page did not believe in this concept. Instead, he believed that each joint had its own vertical, sagittal, and horizontal axes. He held that an axis was always perpendicular to the path of rotation

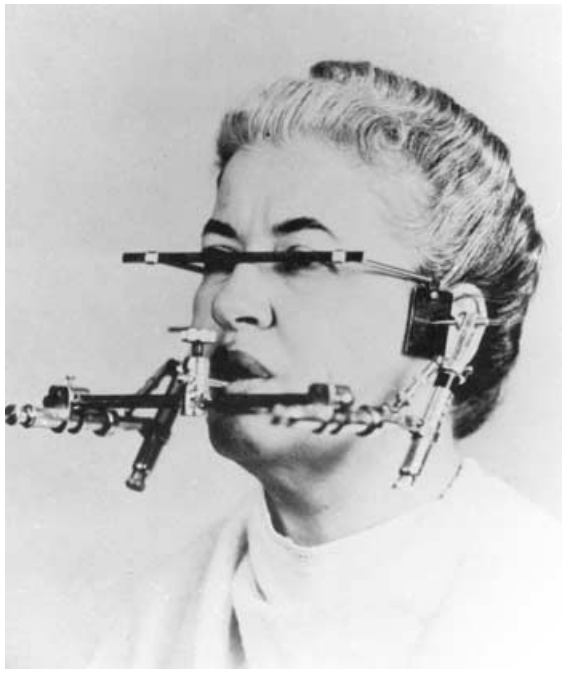

Figure 2. Lower member of the Transograph used as an axis locator (*Copyright Quintessence Publishing Co. Inc.*).

that it controlled, and that the three axes that passed through each condyle did not intersect at a single, common point, (i.e., they were not mutually perpendicular). Page described all three of these axes as intra-fossal (i.e., in the fixed member of the hinge), and not intra-condylar.[14]

Unlike any other articulator, the Transograph was designed with no mechanical connection between the right and left condylar controls. Only the mounted casts joined its posterior elements. The instrument itself was slightly flexible, allowing the upper and lower members to actually "twist." According to the inventor, this "controlled twisting ability" enabled the Transograph to "accurately duplicate" the bodily shifts of the jaw in function.[14]

Trapozzano[15] later pointed out that joining the right and left condylar controls with mounted casts was, in effect, no different than joining them by means of a solid upper member. He especially took exception with Page's claim that Transographics was founded on sound Gnathological principles because McCollum did, indeed, use a "solid hinge axis" while Transographics refuted this principle.

The lower member of the Transograph was initially used as an axis locator and was attached to the patient's mandible by means of a clutch lined with soft plaster (Fig 2).[3] Axis location with this device was similar in technique to that employed by most conventional axis locators. Once the axis was located, the axis points were marked on the patient. The axis locator was then employed as a transfer bow which, in turn, became the lower member of the Transograph. Note that the patient's gonial angle was carefully measured, and the lower member of the instrument was adjusted to precisely duplicate that angle (Fig 3).[13]

The Cranial Reference Plane

Page stressed the necessity of selecting and accurately transferring a reference plane from the cranium to the articulator to correctly orient the occlusal plane in space. He believed that the occlusal plane could only be accurately transferred to an instrument after it had been related to another reference plane (in the patient's head) that had already been established in the articulator.[1,3,6,7,16,17]

Page credited past articulator designers McCollum, Wadsworth, Simon, and others for wisely using such reference planes, but criticized them for using planes established by specific landmarks. He believed that the only requirement in cranial reference plane selection was that it could be repeated in the articulator.[1,3,7,16,17] For each patient, he used an "individual" cranial plane, which was defined by the Hinge Axis and any convenient cranial plane reference point. He used his "Head Relator" (Fig 4),[16] which he set level with the pupils of the eyes to establish his cranial plane. If a patient had a "long" face, he set the "head relator" below the pupils. If the patient had a "short" face, he set the "head relator" above the level of the pupils, (i.e., the cranial reference plane did not need to be exact).[16]

Collateral Bodily Shift of the Mandible in Function

In his review of the literature concerning mandibular movement, Page[1,3,7,18-22] found two opposing theories that attempted to explain the Bennett Movement. Gnathological writers, (i.e., McCollum,[23] Granger,[24] and Lucia[25]) stated that the phenomenon of Bennett Movement was due to the downward, forward, and inward movement

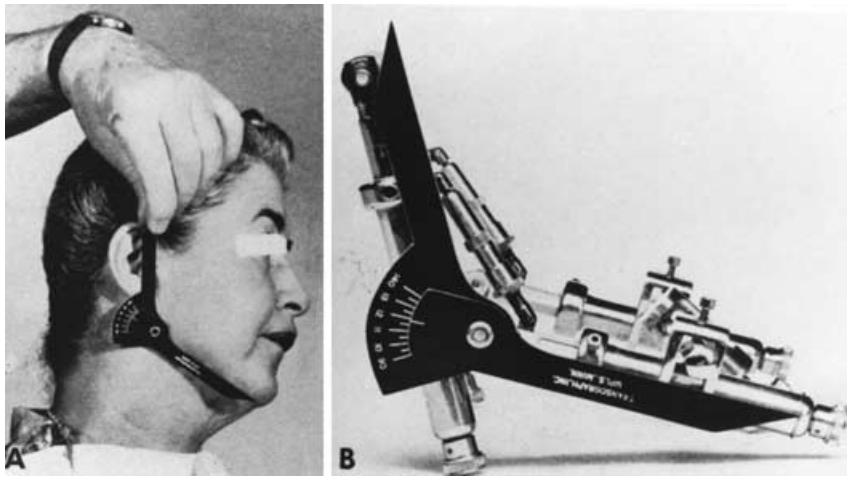

Figure 3. Measurement of the gonial angle and adjustment of the lower member of the Transograph to duplicate that angle (*Copyright Quintessence Publishing Co. Inc.*).

of the nonworking condyle along the "inner curbing" of its fossa. A second theory put forth by Sicher[26] attributed the cause of Bennett Movement to the time lag between contraction of the (nonworking) lateral pterygoid muscle and the (working) temporalis muscle.

Though these two theories contradicted each other, both schools of thought agreed that Bennett Movement was a component of lateral movement.

Figure 4. Head Relator used to relate the Cranial Plane and Transverse Axes to the Maxillary Occlusal Plane (*Copyright Quintessence Publishing Co. Inc.*).

Page,[18,19] on the other hand, believed that Bennett Movement was not a component of lateral movement. Rather, he held it was a component of natural, functional movements, the major of which was vertical movement. Page pointed out that condyles were grossly irregular in shape and size, and that they moved against irregular fossae. Consequently, he believed all jaw movements, no matter what type, involved a certain amount of opening or closing movement. He further postulated that, in order for the jaw to function at all, it had to somehow compensate for the unequal radii, shapes, positions, and sizes of temporomandibular joints. Bodily shifts of the jaw at the individual fulcra points, which provided this compensation, were made possible by loosely encapsulated condyles.[1,3]

Page felt it next to impossible to build an articulator capable of duplicating the bodily shift of the mandible upon opening and closing. He further pointed out that this was a very difficult, expensive, and unnecessary way to address this problem.[3] He believed that he could duplicate Bennett Movement by equivalence (i.e., by using a slightly flexible articulator employing close fitting "pin-in-sleeve" bearings as opposed to a rigid instrument). He felt that the slightly flexible Transograph could twist to compensate for the misalignment of individual axes present in the jaw, thereby yielding equivalent movements. Page claimed that transfer of the Transverse Axes misalignment automatically created a Bennett Movement in the Transograph when the right and left components of the instrument were joined by mounted casts.[3]

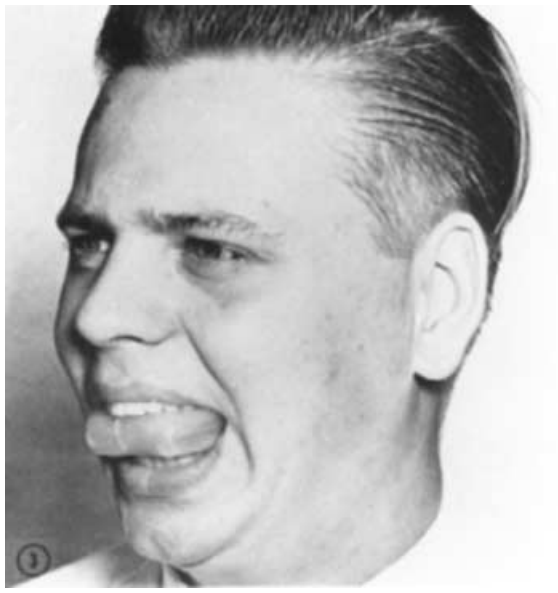

Figure 5. A series of three lateral records of varying thickness was made on each side. Page believed this ensured independent capture of each of the three axes of each joint (*Copyright Quintessence Publishing Co. Inc*.).

The Envelope of Motion

A basic tenet of Transographics was that the articulator needed only to follow a patient's "envelope of motion," and further, that teeth free of interferences at the borders of that "envelope of motion" were automatically free of interferences at any point within the envelope.[1,3,7-9,11,27]

Harry Page believed that he could capture the "envelope of motion" by locating and reproducing the control centers. Since he believed that each condyle rotated in all three dimensions, he felt it necessary to capture the three rotational axes for each condyle.[27] Page held that the complete envelope of motion included bruxing positions, which could be very detrimental. So, he focused on a pattern of non-interfering function lying somewhere inside the "envelope of motion." He further believed that pattern to be controlled by the same axes that controlled the entire envelope, and that nothing changed during function except the amplitude of the components of movement.[1]

To ensure independence of the three axes in each joint, Page made three lateral check bite records on each side. Each of the three records was made at a slightly different position along the path of lateral movement (Fig 5).[28] The right and left condylar controls of the Transograph were released while the mounted casts were fitted into the records. That eliminated the influence of the rotating condyle, as was the case in other articulators. Hence, his lateral check bite records influenced the adjustment of both condylar controls (Fig 6).[28]

Page and his followers believed that condyle paths varied as a result of interfering cusps, prosthodontic appliances, and variations in foods encountered at the occlusal surfaces of the teeth. Because of this variation in the path they further believed that it could never be duplicated by any fixed condyle slot in an instrument.[27] They also held that the translating condyle had no set path since it had no way of being braced against the eminence throughout its excursions. This belief was based on pantographic tracings of the jaw in function which showed movements of the translating condyle to be erratic.[27] Page argued that the true pattern of jaw function was quite different from the "boundaries of condylar movements." He asserted that the value of pantographic tracings lay not in finding and transferring movement boundaries of the translating condyle, but in how well those tracings permitted location and transfer of the axes of the working condyle.

Transographics—A Unique Concept

The Transograph was an articulator like no other. Although Harry Page tried to align himself with the gnathologists, some elements of his theory of Transographics undoubtedly made many gnathologists cringe. This article has sought neither to defend nor criticize the Transograph or the theories upon which it was based. The intention has been to look at Harry Page and his instrument in a historical context.

Though some time has been spent in this article explaining some of Page's theories and how they were reflected in the Transograph, this was only done to assist the reader with enough basic knowledge to make some sense of the construction and programming of this most unusual articulator. It was only through a thorough study of Page's prolific writings on this topic that any real understanding of Transographics could be reached. His articles were interesting and enthusiastically written, but somewhat confusing. The fact that Harry Page gave so many demonstrations, clinics,

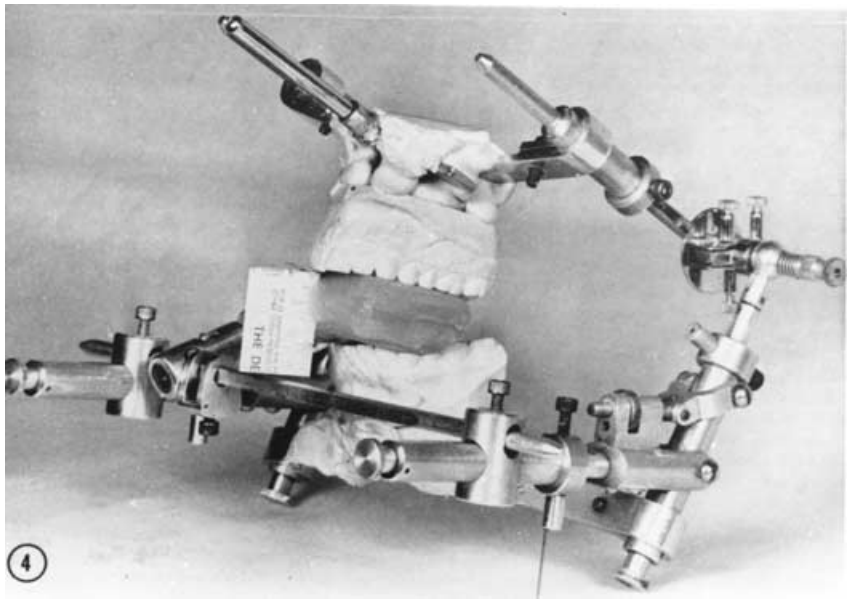

Figure 6. Each of the lateral records influenced the setting of both condylar controls (*Copyright Quintessence Publishing Co. Inc.*).

and study clubs suggested that even he understood the potential difficulty in grasping his concepts and correctly using the Transograph by simply reading his articles. He posed some very thought provoking points in his papers. His articles on centric relation,[29] jaw protrusion,[30] and balanced occlusion[31] certainly added to the controversy[15,32] spawned by his other articles. His enthusiasm was all too obvious in his "Envelope of Motion" article.[27] In it he boldly proclaimed his beliefs with a confidence akin to that of Bonwill, whose proclamations seemed to be divinely inspired. His articles were also full of many practical and understandable analogies. Some of his terminology, if not professionally correct, was nonetheless colorful and easily understood (e.g., he referred to para-functional movements as "doodleing"[18]).

Figure 7. Henry L. "Harry" Page (*circa* 1917). Photo courtesy of the Archives of Hotchkiss Preparatory School, Lakeville, CT.

Epilogue

Alas, the Transograph did not withstand the test of time and has all but slipped into obscurity. Surviving instruments have been abandoned to display in articulator collections where curious students gaze upon them and scratch their heads in wonder at how in the world the thing worked. Nonetheless, Harry Page did make a great contribution to dentistry. The lively debates which his ideas and prolific writing stimulated, have undoubtedly, brought the profession to a greater understanding of the dynamics of the impression procedure and mandibular movement.[33]

Author and Inventor

Henry L. "Harry" Page was a native of Connecticut who received his formal education at the

Hotchkiss Preparatory School (Fig 7) and Yale University. His college years were interrupted by World War I. During the war, he served as a flying officer (both as a pilot and as a flight instructor). Following the war, he completed his formal training and embarked on a career as a heat exchange engineer. His sojourn into dentistry began at a luncheon in 1937 when two Los Angeles dentists explained to him how most edentulous patients experience a stability problem with mandibular dentures. His intense interest in using physics and engineering principles to solve this challenging problem led to the development of the mucostatic impression technique. Later in 1950, with the cooperation of Dr. Rubin N. Albinson of Minneapolis, he established the concept of Transographics. He devoted over 30 years to dental research and teaching the practical application of Mucostatics and Transographics. He contributed numerous articles to the dental literature concerning both of these philosophies. Many of his articles have been translated into foreign languages. He lectured at many study groups, Academy meetings, and dental schools across the United States.[1,3]

References

1. Page HL: Fundamentals of practical articulation. Dent Dig 1959;250-254
2. Page HL: Transographics—a summary. J Colo Dent Assoc 1969;47:36.
3. Page HL: Transographic duplication of jaw function using kinetics—Reprint Part I. TIC Magazine, 1963:12:9-2-5; Part II. TIC Magazine, 1963:12:10:5-9; Part III. TIC Magazine, 1963:12:11:3-5; Part IV. TIC Magazine, 1963:12:12:13-16; Part V. TIC Magazine, 1964:13:1:14-15; Part VI. TIC Magazine, 1964:13:2:5-11. Ticonium Div/CMP Industries, Inc., 1964.
4. Page HL: Dental instrument. U. S. Patent No. 2,982,025, May 2, 1961.
5. House JJ: The design and use of dental articulators in the United States From 1840 to 1970—Thesis. Indianapolis, Indiana University, 1970, pp. 210-214
6. Page HL: Temporomandibular joint physiology and jaw synergy. Dent Dig 1954;60:54-59
7. Page HL: Transographics and the transograph: Part I. Dent Dig 1956;62:162-167
8. Page HL: Transographics and the transograph: Part II. Dent Dig 1956;62:214-219
9. Page HL: Some confusing concepts in articulation: Part I. Dent Dig 1958;64:71-76
10. Page HL: Some confusing concepts in articulation: Part II. Dent Dig 1958;64:120-124
11. Page HL: Hinge-axes: arguments and typical examples: Proof: Part I. Dent Dig 1960;66:368-372
12. Page HL: Hinge-axes: arguments and typical examples: proof: Part II. Dent Dig 1960;66:411-415
13. Page HL: The hinge bow. Dent Dig 1952;58:534-537
14. Page HL: Fundamentals of practical articulation. Dent Dig 1959;65:250-254
15. Trapozzono VR: Discussion of the transograph and transographic articulation by Jerome M. Schweitzer, D.D.S. A J Pros Dent 1957;97:622-624
16. Page HL: The cranial plane. Dent Dig 1955;61:152-157
17. Page HL: Natural articulation movements. Dent Dig 1953;59:202-206
18. Page HL: The Bennett movement: Part I. Dent Dig 1955;61:344-349
19. Page HL: The Bennett movement: Part II. Dent Dig 1955;61:395-398
20. Messerman T, Walsh PW: Mid-States Dento-Occlusal Symposium: concepts of occlusion—transographics and the evolution of the transograph. Dent Clin of N Am 1963;7:637-647
21. Page HL: Transographics principles and practice for technicians: Part I, Principles. National Association of Dental Laboratories 1961;1(8):1-14
22. Page HL: Transographics principles and practice for technicians: Part II, Practice. National Association of Dental Laboratories 1961;1(9):1-16
23. McCollum BB: Oral diagnosis. J Am Dent Assoc 1943;30:1218-1233
24. Granger ER: Functional relations of the stomatognathic system. J Am Dent Assoc 1954;48:638-647
25. Lucia VO: The fundamentals of oral physiology and their practical application in the securing and reproducing of records to be used in restorative dentistry. J Pros Dent 1953;3:213-231
26. Sicher H: Positions and movements of the mandible. J Am Dent Assoc 1954;48:620-625
27. Page HL: The envelope of motion. Dent Dig 1956;62:358-361
28. Page HL: Lexicography, hinge opening, hinge closing, and centric. Dent Dig 1955;61:17-23
29. Page HL: A critical appraisal of centric relation. Dent Dig 1953;59:342-345
30. Page HL: Temporary protrusion, its causes and correction. Dent Dig 1956;62:20-25
31. Page HL: An appraisal of balance. Dent Dig 1954;60:200-204
32. Schweitzer JM: The transograph and transographic articulation. J Pros Dent 1957;7:595-621
33. Ed. Staff: News of the industry. Dent Lab Review 1941;6:24