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The History and Development of the Football Helmet

Paul E. Quam

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This abstract of a thesis submitted by Paul E. Guam in partial fulfillment of the requirements for the Degree of Master of Science in the University of North Dakota is hereby approved by the committee under whom the work of the thesis has been done.

W.C. Koenig
Chairman

[Signatures]

Dean of the Graduate School
THE HISTORY AND DEVELOPMENT OF THE FOOTBALL HELMET

Paul E. Quam, Master of Science

This thesis here abstracted was written under the direction of Walter C. Koenig, and approved by John L. Quaday and Allan W. Sturges as members of the examining committee, of which Mr. Koenig was Chairman.

In tracing the history and development of the football helmet in its origin and evolution, the study related the changes in design of football headgear. Numerous photographic plates included throughout the chronicled data depict graphically the changes which occurred. These photographs provide a proper perspective for an understanding of the present day football helmet.

An account of the explanation proffered by designers of helmets, with reference to selection of style, has been included.

Analyzing the particular details in design of football headgear, the study alludes to the different attitudes held by both coaches and players toward the game itself.

Finally, an appraisal of strides made by sporting goods companies toward the gradual betterment in design of the football helmet was presented. Although criteria for design of effective headgear were not discussed, the principles
for its basis have been indicated in the historical accounts of helmet systems.
This thesis submitted by Paul E. Guam in partial fulfillment of the requirements for the Degree of Master of Science in the University of North Dakota, is hereby approved by the Committee under whom the work has been done.

W.C. Koenig  
Chairman

John L. Quada  
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Christopher J. Hamre  
Dean of the Graduate School
THE HISTORY AND DEVELOPMENT OF
THE FOOTBALL HELMET

by
Paul E. Quam
B.A. in History, St. Olaf College 1956

A Thesis
Submitted to the Faculty
of the
University of North Dakota
in partial fulfillment of the requirements
for the Degree of
Master of Science

Grand Forks, North Dakota
August
1965
FaTore in the completion of this thesis.
Whose encouragement and assistance were major.

To my wife.

DEPICTION
ACKNOWLEDGMENTS

The author wishes to express his appreciation to Mr. Walter C. Koenig, Director of Graduate Study in Physical Education, to Dr. John L. Quaday, Chairman of the Department of Physical Education, to Dr. Allan W. Sturges, Department of Education, for their invaluable guidance, constructive criticisms, and high standards of evaluation, and to Mr. Fred A. Rappleyea, Director of Research, John T. Riddell Company, Mr. Richard Mickley, and Mr. Dick McCann, of the National Professional Football Hall of Fame, Mr. Richard M. Lamb, Director of the Football Information Bureau, and to Dr. Harold A. Fenner, Orthopedic Surgeon, for their assistance and encouragement.
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CHAPTER I

INTRODUCTION

Throughout the long history of mankind man has sought means of protecting his head from blows of war, sport, or accident. Archeological studies indicate the existence of war helmets as far back as the fourth millennium B.C.¹ The first historical description of a helmet, however, is found in Homer's "Iliad". Diomedes and Ulysses were about to make a night reconnaissance of the Trojan camp. In the translation of E. V. Rieu, the arming of the heroes is described.

"On his head he put an oxhide casque without peak or plume, of the sort called 'skull-cap' which young gallants wear to protect their heads. Meriones gave Odysseus a bow, a quiver and a sword, and set a leather helmet on his head. Inside it there was a strong lining of interwoven straps, under which a felt cap had been sewn in. The outer rim was cunningly adorned on either side by a row of white and flashing boars' tusks."²

The history of the game of football is not a long one, but early in the development of the game players became aware of the necessity of protecting their heads from the blows


encountered in the rugged play. The football helmet has
gone through numerous stages of development during its brief
history. However, research that is being done in this field
seems to indicate that we may expect more changes in the near
future.

**Purpose**

The purpose of this study was to trace the history of
protective headgear worn by football players, and to reveal
the underlying influences which have caused changes in helmet
design. It was not the purpose of the author to make correla­
tive studies of the development of football headgear with
regard to significant safety factors, practibility, or func­
tional value. The photographs included in this study fulfil
a vital aspect of the purpose of this thesis by defining,
with clarity, the various trends of helmet design.

**Need for the Study**

Little definite historical data has been organized
to simply define the development of headgear from its numer­
ous and varied origins. An accurate and concise observation
will surely find a berth of usefulness. It is the writer's
sincere hope that this research can fulfil such a need.

During a visit by this author to the National Pro­
fessional Football Hall of Fame in December, 1964, a specific
request for this type of information (the topic of this
research) was expressed by officials there. In addition,
during the period of correspondence for this study, various
individuals representing both the fields of medicine and physical education encouraged the author in this study. It became clear that a compilation of data, particularly photographs, would enhance further research as well as provide a basic historical outline.

To this writer's knowledge, no study yet published solely concerns itself with the development of football headgear from its beginnings.
CHAPTER II

RELATED LITERATURE

In 1961, Carlini developed and evaluated a new design for a football helmet. This design incorporated an air cushion suspension inside a hard, fiber glass shell. Tests consisting of applying gauged blows were used to compare this helmet and a conventional plastic helmet, utilizing a web suspension system. The study showed that the air cushion helmet was superior to the web suspension type in impact absorption.3

In a study of the energy attenuating abilities of a series of commercially available football helmets and of several experimental helmets, Snively, Kovacic, and Chichester4 found that the ability of a group of commercially available football helmets to attenuate impact energy was appreciably inferior to that of several racing crash helmets. Prototype football helmets utilizing energy absorption design principles similar to these racing helmets were developed and found to


have superior energy handling ability in the laboratory. Actual field trial under both practice and game conditions of these prototype helmets indicated an appreciable gain in comfort as well as an increased protection against high energy impact on the head.

A study that is being conducted by Dr. Stephen E. Reid, an associate professor of surgery at the Northwestern University Medical School, Dr. Joseph A. Tarkington, a neurosurgeon, Thomas E. Healion, the Northwestern Athletic Department's head trainer, and the John T. Riddell Company, is attempting to find out how efficiently football helmets protect players' heads and how the equipment can be improved. Specific objectives of this study are as follows:

1. To obtain statistically reliable impact data on blows falling on the helmet.
2. To identify from what direction the blows came.
3. To determine (as a future phase) the feasibility of radio telemetry in electro-encephalography and to correlate the forces of impact with the electro-encephalogram.
4. To determine the frequency of blows.
5. To locate where the blows fall on the helmet.
6. To establish design criteria for safer football helmets.

Data are being gathered for this study by installing instrumentation. XVII (First Quarter, 1964), pp. 30-34.
a triaxial accelerometer in a Riddell helmet. The "G" values from the accelerometer are telemetered from a miniature radio transmitter built into a helmet and set of shoulder pads, worn by Northwestern fullbacks, to the press box where they are recorded as three separate traces on a Honeywell Visicorder instrument.

Although this study will continue during future football seasons, it has shown instantaneous "G" values ranging from 71 to 5,760, but 85 per cent of the blows registered "G's" in the range of 400-1,000. During 50 per cent of the time that the instrumented player was in play, he encountered no contact. The majority of impacts were encountered by the sides of the helmet and a moderate number were received by the front, while relatively few were encountered by the top of the helmet. This study will continue until sufficient data are obtained to produce design criteria upon which to base the football helmet of the future.

In a study of seventeen different types of headgear, Miller\textsuperscript{6} found that even the best of the helmets fell short of providing adequate protection against injuries at three sites—the front, the rear, and the lower rear.

Chosen for testing were sixteen of the highest-priced football helmets manufactured by the sporting goods industry and one experimental model. Three replicas of each model

were subjected to two impact velocities of 47 and 78 foot-pounds at each of six positions—front, back, top, side, lower back, and oblique. Each helmet was also subjected to bottoming and to penetration tests to determine shell rigidity. On all helmets the top, oblique, and side positions provided satisfactory protection when impacted with 78 foot-pounds. The lower back, front, and back appeared to offer insufficient protection to the wearer. The poorest area of protection was the lower back position. A helmet consisting of a fiber glass shell with an expanded polystyrene liner was found to be the most effective of the lot and had the lowest peak acceleration at the three poorest impact positions.
CHAPTER III

METHOD OF OBTAINING DATA

Information for this study has been obtained through visits to the National Football Foundation and Hall of Fame, New Brunswick, New Jersey; the National Professional Football Hall of Fame, Canton, Ohio; John T. Riddell Company and Wilson Sporting Goods Company, Chicago. During these visits the author was able to interview officials, examine and photograph obsolete football helmets. Spalding Official Football Guides dating from 1886 to the present time were examined in Davenport, Iowa, at the Football Information Bureau directed by Mr. R. M. Lamb, historian of the National Football Foundation and Hall of Fame.

Research on this topic has been conducted at the libraries of the University of Minnesota, University of North Dakota, St. Olaf College, the Minneapolis Public Library, and through inter-library loan of masters' theses and doctoral dissertations with the cooperation of Indiana University, Northern Illinois University, Michigan State University, and the State University of Iowa.

Among numerous sources which supplied information and resource materials were: the American Medical Association, National Collegiate Athletic Association, The American Football

Additional information has been gathered through correspondence with medical doctors, physical educators, college and university athletic departments, and present and former football coaches.
CHAPTER IV

When Rutgers and Princeton clashed on November 6, 1869, the first intercollegiate football game took place. To distinguish themselves from the Princeton players, the Rutgers players wore scarlet caps or flaming red jerseys.\(^7\) Headguards were unknown, and players allowed their hair to grow long to absorb shock.

Numerous styles of headdress marked the early years of intercollegiate football. In a game played between Harvard and McGill Universities in April, 1874, the Canadians covered their heads with turbans while the Elis had magenta-colored handkerchiefs bound around their heads.\(^8\)

Small visored caps were worn by the Princeton team of 1876, a striking contrast to the stocking caps topped with small knobs worn by the Yale team.\(^9\) Another cap that was popular during this period was a long-tasseled stocking cap called a toboggan toque.\(^10\)

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\(^9\) Ibid.

"Crysanthemum" hair styles were adopted by the Princeton Tigers of 1889, as a protection against head injuries. This fad swept the country, and football players with their unsightly mops of hair became the delight of cartoonists. The fashion continued until a championship Yale team appeared with close-cropped heads in 1895.11

The noseguard made its appearance in 1890, when a particular nose guard was designed by the Harvard captain for Edgar A. Poe, Princeton's captain, who had previously suffered a nasal injury. He used it in the Yale game, and its novelty created some excitement, but he was permitted to wear it.12 In 1891, a hard rubber combination nose guard and mouthpiece (see PLATE I, p. 12) was patented and often used by all eleven players on a team.

The Spalding Official Football Guide of 1892 advertised the following cap:

"This new cap is designed for protection of the ears and hair. Made of woven silk and thread and very close fitting. Players suffering with sore ears, it is an absolute protection. Used the first time last year by leading football players. For use in match and practice games it is indispensable.13 Price, Each $2.50

There is considerable conflict among authorities as to the first use of the head protector or as it was more

PLATE I.—Morrill hard rubber combination nose guard and mouth piece, commonly called the "head harness".

The earliest date of usage, detected by this author, is a reference by Morris Allison Bealle in his book Gang Way for Navy which contains a photograph (see PLATE II, p. 13) of the late Admiral Joseph Mason Reeves as he looked in the 1893 Army game wearing his own invention—the football headgear, or helmet. Naval Cadet Reeves had it made to his specifications by an Annapolis shoemaker, after a Navy doctor had warned him that another kick in the head most likely would mean insanity.14

A contrasting opinion concerning the initial usage of the head protector appeared in the Philadelphia Sunday Bulletin.

expressing that in the fall of 1896, the threat of "cultivating cauliflower ears" led to the development of the first head protector. Lafayette College halfback George Barclay was worried about the growth of his hearing organs, which he attributed to "playing bareheaded". He designed a headgear which had three thick leather straps forming a tight fit around his head and had it made by a harness maker. It was only logical that it became known as a head harness. Barclay first donned this head harness for Lafayette's "fierce and furious" gridiron battle with the University of Pennsylvania.
Spalding’s Head Harness No. 30
at Philadelphia.

The development of football headgear has not until recent years been based upon scientifically gathered data. During the early years of development, sporting goods companies turned to coaches and athletic trainers for advice on headgear design.

PLATE III.—Spalding's Head Harness No. 30.

Spalding's Official Football Guide for 1901, carries the following advertisement:

Spalding's Head Harness No. 30 (see PLATE III, above)

"The latest addition to our line of Head Harness was designed by H. B. Conibear, the well known trainer of the University of Chicago. The crown piece is made of heavy oak tanned leather, molded to shape and lined inside with a circular piece of felt to relieve any undue pressure on the top of the head. The ear pieces are well
padded and perfectly protect these members. An exceedingly light and comfortable harness, yet amply strong. #30 Each. $3.00 17

Pneumatic head harnesses were placed on the market by the A. G. Spalding Company in 1903 (see PLATE IV, below). They were made of soft black rubber with an inflated crown, and space was provided in the crown for ventilation through openings in the heavy wool felt which was used. 18 This head harness was very popular when it was introduced. However, its popularity was short lived, and by 1905 it appeared to

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have been discarded.

High schools and colleges throughout the country became absorbed with the game of football and it expanded greatly in the early 1900's. Professional football was also making its start. To meet the new demands for equipment, athletic manufacturers were hard at work designing and developing new and safer equipment, and an increasing number of head harnesses was one of the results of their efforts. By 1907 there were five different styles.\textsuperscript{19} Accent was on protection of the head and ears, but some models began to reflect the importance of protection of the neck as well. Certain types featured protective flaps attached to the helmet proper, while other helmets were designed in a solid piece built down to cover the ears. The Rawlings' Catalog for the 1909 season described the top head harness (price $3.00) as being made of fine black horsehide, with welded seams, heavily padded, and with neck protector.\textsuperscript{20} The word "helmet" was beginning to make an appearance as some head harnesses were listed as being "helmet patterns".\textsuperscript{21}

At this point in football history, the head harness was not a universally accepted piece of protective equipment. Old timers of the game thought such head guards "sissy",

\textsuperscript{19}Baker, \textit{loc. cit.}


\textsuperscript{21}Ibid.
contending that no real football player would wear one. One of the leading coaches of that day, Glenn S. Warner, had some misgivings about the value of the head harness when he wrote:

Many players do not care to wear head protectors of any kind as they interfere to some extent with the hearing, are warm, and add weight to the uniform. Others will not play without them as they claim a head protector gives them more confidence, saves their head from many hard jolts, and keeps their ears from becoming torn or sore. I do not encourage their use, nor do I object if the players I am coaching prefer to wear them. I have never seen an accident to the head which was serious, but I have many times seen cases when hard bumps on the head so dazed the player receiving them that they lost their memory for a time and had to be taken out of the game, and I believe that the men who carry the ball would do well to wear light head protectors to guard against such temporary injuries.

Good head protectors can be had at all prices, and in all grades from those made from the crown of an old felt hat with ear laps sewed on and connected under the chin by a strap, to the elaborate ones placed on the market by the sporting goods firms, and one affords about the same protection as the other.

No player with any nerve at all wears a nose guard nowadays unless he has a sore nose. They prevent clear vision, interfere with the breathing, add weight to carry around and provide very little protection. They should only be worn in cases where the nose is recovering from an injury.

Terms often used to describe head harnesses in advertisements during the first two decades of the twentieth century were "soft leather" and "light as a feather". The 1905 Rule

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Book stated that if a player wore a head protector made of sole leather, papier-mâché, or other hard or unyielding material, and did not remove it he would be disqualified.\textsuperscript{24}

Some coaches and trainers believed that hard equipment caused injuries and fatigue to the players.\textsuperscript{25} Coaches were asking for lightweight equipment so the speedy backs would not be slowed down by the weight of their uniforms.

In 1917, the Spalding Company introduced the first

PLATE V.—A head harness used during the first decade of the twentieth century.

\textsuperscript{24} Fielding A. Yost, Football For Player and Spectator (Ann Arbor, Michigan: University Publishing Co., 1905), p. 299.

\textsuperscript{25} Herbert Reed, Football For Public and Player (New York: Frederick A. Stokes Co., 1913), p. 98.
Suspension Head Harness. This head harness had an eight point elastic strap suspension which was designed to keep the head away from the top of the head harness. The guard itself was made of firm black leather with felt padding, and had holes for ventilation. It also had an elastic, adjustable head band.26 The Rawlings Company introduced a head harness offering more neck protection than ever before. The rear of the head harness came well down over the neck and was catalogued as a "rear extension to protect back of neck". The new model also featured a leather forehead sweat

PLATE VII.--A head harness that was popular from 1906-1914. Made with a fabric cover and felt padding.

band and a padded chin piece.²⁷

Head harness construction during the first twenty years of the twentieth century was generally characterized by a soft leather shell padded with felt. The head harness manufacturers were greatly influenced, during these early years by prominent coaches and trainers.

The "Dreadnaught" head harness, a popular collegiate model, was manufactured by Stall & Dean Company in the early 1920's. This head protector was made from strap leather, reinforced with hard, vulcanized fibre, and featured a suspension crown. The ears and back piece were lined with

²⁷"From Head Harness to Head Cushion", loc. cit.
PLATE VIII.—(top) This head harness manufactured about 1910, constructed of strap leather with felt padding. An elastic strap in front adjusted to head size. (bottom) A felt padded head harness with web suspension. Manufactured about 1920.
felt and covered with leather. 28

The Bob Zuppke model head protector, designed by the famous University of Illinois coach, was introduced by the Rawlings Company in 1925. (see PLATE IX, below) This head protector was made of tan colored strap leather, light in weight, and featured a sponge rubber crown, reinforced with felt and fibre. This head protector sold for $12.00. 29

A. G. Spalding Company introduced its famous line of

PLATE IX.—Bob Zuppke model head protector. First manufactured by the Rawlings Company in 1925.

28 Letter from Mr. R. G. Stall, Stall & Dean Manufacturing Co., Inc., Brockton, Mass., November 2, 1964

29 "From Head Harness to Head Cushion", loc. cit., p. 9.
"ZH" helmets in 1926 (see PLATE X, below). This helmet was advertised as follows:

No. ZH "Big Ten Model" Gives complete protection. Black or tan; head rests against heavy roll patent web-strapping, absorbing shock; white felt lined; fibre reinforced; leather lined throughout; fits snugly; new improved ear pieces molded to shape avoids bruised ears; snap elastic, with soft leather pad under chin; top of helmet reinforced with cross strips of fibre. Helmet will hold its shape and remain hard. In use on the best equipped teams. Made in all sizes. Each. $9.00.30

PLATE X.--A. G. Spalding's "ZH" Big Ten Model

Although the football helmet was not universally

worn by all football players, nor was it as yet required by rules, coaches and players as well realized its importance. Glenn "Pop" Warner, who earlier in his career had questioned the importance of the helmet now advocated it when in 1927 he wrote:

> All players should wear head protectors or helmets during the games and scrimmage practice. These should be as light in weight as is compatible with adequate protection. They should come well down in front to just above the eyebrows so as to prevent cuts over the eyes through the collisions which will occur often, and they should come well down in the back to protect the base of the brain. A bridged-over top, the helmet resting on webbing or leather supports rather than directly on the head, is much preferable to soft padding, since this method better distributes shocks. The ear protectors should have large holes in them to enable the wearer to hear plainly. In the ordinary helmet the ear holes are too small to insure good hearing. The holes are made small so that the ears cannot come through. Some sporting goods houses, at my suggestion, are now making the holes in the ear protectors much larger and covering them with fine wire gauze to prevent the ears from coming through the hole.31

By 1928, the term "head harness" had been discarded in favor of "head helmet".32 Prior to this time, some head protectors had been referred to as helmet patterns.

Helmets designed or endorsed by famous coaches and players were popular in the late 1920's. Stall & Dean Company advertised the D. X. Bible Helmet, C. W. "Doc" Spears Varsity Helmet, and Gauthier College Helmet.33 Rawlings

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32 Baker, loc. cit., p. 596.
33 Stall & Dean, Official Football and Soccer Rules (Chicago: Stall & Dean, 1929).
was advertising the Bob Zuppke Helmet and the Navy Helmet. Wright and Ditson advertised the Fielding Yost Helmet and the Tad Jones Helmet, while Draper-Maynard Company advertised a Knute Rockne Brand Helmet, a Pop Warner Helmet, and a Tuss McLaughry Helmet.

The famous Notre Dame football coach, Knute Rockne, listed the qualities that he believed a football helmet should contain when he wrote:

> The most important items in the head-gear are that they must cover the medulla oblongata and over the outer corners of the eyebrows. The holes over the cup around the ears should be large so that there can be no interference with the sense of hearing. The head-gear should be well ventilated. In southern states felt should be absolutely eliminated. Webbing or leather cups in the crown of the head-gear are superior to rubber for the reason that they distribute the shock better. Rubber does not distribute a shock. The head-gear should be purchased to exactly fit the head.

Fatalities from football reached unexpected proportions during the 1931 season. The death of a West Point cadet spearheaded the establishment of a factual study of injuries and fatalities by the American Football Coaches Association. This committee was chaired from 1931 to 1941 by Marvin A. Stevens, M. D., then of Yale. In a book co-authored by Dr. Stevens and Dr. W. M. Phelps, the

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34 *Athletic Journal, IX* (July, 1929), p. 35.
35 *Athletic Journal, VII* (March 1927).
headgears of the day are discussed as follows:

Probably the most important piece of equipment for the football player from the standpoint of preventing serious injury is the headgear. There has been a tendency to make headgears heavier, larger, and harder in the past few years in a vain attempt to curb an increasing number of head injuries. This has resulted, in many cases, in the helmets becoming offensive weapons on the heads of powerful, heavy, hard-hitting line plungers and yet not acting as shock absorbers for the cranium of the wearers. The heavy, molded, padded leather is stiff enough to prevent scalp wounds and contusions. However, while it will not collapse under the blow of a hammer, it fails to absorb the shock of such blows as kicks from shoes or blows from the knees or from the force of blows such as the head striking the ground, which are transmitted to the base of the brain, or to the opposite side of contra-coup. Except for the bulk, a player would be far safer with his head swathed in cotton batting, or in a casque made of Belgium rubber or other suitable resilient material. Pneumatic helmets and headgear with small spring shock absorbers should be seriously experimented with and a football headguard evolved which will practically eliminate serious cerebral accidents. There has not been sufficient co-operation between the practical manufacturer, the experienced coach and trainer, and the neurological and orthopedic surgeon in the art of designing football equipment. It is well within the bounds of reason that within a short space of time football equipment can and will be materially improved, and we look forward confidently to the near future when vastly improved headgear will eliminate all serious head injuries.\(^3\)

An integrated nose protector helmet was placed on the market by Rawlings in 1929. The nose protector part of the helmet was made of heavy sole leather. It completely covered the nose and was attached to the helmet proper at the forehead and at the sides of the helmet. There were two large openings for the eyes. Padded on each side of the nose

with sponge rubber, the nose and cheek piece was reinforced with soft steel that could be bent to the individual's profile. 39 The Spalding Company introduced a similar helmet in 1931 (see PLATE XI, below). This helmet was basically the same construction as the Spalding "ZH" helmet with the addition of the leather covered metal nose protector. These nose protector helmets were short lived and did not become popular.

The majority of the helmets manufactured during the early 1930's were constructed with a vulcanized fibre crown which was covered with leather. A suspension system of web

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PLATE XI.—Spalding’s "ZH" nose protector helmet.

39 "From Head Harness to Head Cushion", loc. cit.
straps kept the top of the head from coming in contact with the outer shell. The front, sides, and back were padded with felt. Felt provided a fairly good shock absorber, but it was warm and would soak up perspiration in warm climates. Wet weather was also hard on felt padding as it would absorb water and mud.

PLATE XII.--Spalding "MOS" helmet constructed with an eight point web suspension and padded with felt.

The middle 1930's saw the introduction of Airlite-Cushion-Rubber as a replacement for felt padding. This material eliminated some of the disadvantages that were inherent in felt padding.

In the late 1930's a new innovation was introduced
into helmet construction when Wright and Ditson Company, in cooperation with Bernie Bierman, the University of Minnesota football coach, designed a helmet (see PLATE XIII, below) that allowed the head to snap back without putting pressure on the back of the neck. Another new feature of this helmet was that it had a rather thick layer of sponge rubber compressed between the fiber top and the leather covering. Compressed sponge rubber padding eased the shock of a blow on the wearer and the opponent who might come in contact with it. The Wisconsin State Athletic Association urged

PLATE XIII.—The "Minnesota Helmet"

40 Letter from Mr. Bernie Bierman, former University of Minnesota football coach, January 18, 1965.
Helmet of Fordham Player in Early Thirties
PLATE XIV. -- (top) A helmet manufactured by Goldsmith, featuring a foam rubber suspension covered with leather. (bottom) A helmet manufactured by Wilson about 1934.
all its members to purchase and use this type of helmet. Football helmets were not required to be worn by players until the National Collegiate Athletic Association Rules Committee in 1939 introduced a rule stating "all players must wear head protectors."

A revolution in the football helmet manufacturing industry started in 1938. This was the year when the John

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PLATE XVI.—A rear and inside view of a Rawlings helmet manufactured in the 1930's.
T. Riddell Company produced the plastic shell football helmet with the Riddell suspension.\textsuperscript{43} The type and construction of the early Riddell helmet is fundamentally the same as is produced today. However, numerous changes have evolved due to the availability of improved and new materials and to better utilization of energy absorbing systems in the helmet (see PLATE XVII, below).

The advent of World War II and the scarcity of plastic during the war delayed the promotion of the Riddell

PLATE XVII.—Riddell's first plastic helmet used in the 1939 All-Star Game.

\textsuperscript{43}Letter from Mr. Fred A. Rappleyea, Director of Research, John T. Riddell Co., Chicago, Ill., August 5, 1964.
PLATE XVIII.—A plastic helmet manufactured by MacGregor Goldsmith about 1950. It featured a leather suspension system.
NEWLY DESIGNED SNAP-IN CHEEK PADS

MACGREGOR'S EXCLUSIVE GEODETIC SUSPENSION® CRADLES THE HEAD

POSITIONING OF INTERIOR PADDING
plastic helmet until 1946 and 1947. However, the football team of the United States Military Academy at West Point used this helmet during the War. Publicity received by "Doc" Blanchard and Glen Davis, "Mr. Inside and Mr. Outside", created interest in the plastic helmet. Riddell's first helmet was made of tenite plastic.

Plastic helmets became the vogue during the 1950's. Although every helmet manufacturer had at least one plastic model on the market, the types of suspension or cushion varied greatly.

PLATE XIX.—Geodetic suspension system used in the helmets manufactured by MacGregor.

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Dr. Edward Dye, of Cornell Aeronautical Laboratories, designed the Cornell helmet in 1952. A feature of this helmet was the so-called geodetic suspension (see PLATE XIX, p. 35). Essentially, the geodetic suspension does not differ from the conventional vertical suspension in any way except that the straps which form this suspension do not meet and cross over the top of the head at an imaginary north pole. The effect of this suspension is to more or less cradle the head and prevent a relative motion of the head to the helmet. 45 This

PLATE XX. "Head Cushion" system of shock absorption as shown by the head hammock on the left and six point suspension on the right.

45American Medical Association, loc. cit., p. 38.
type of suspension is used in helmets manufactured by MacGregor.

Since 1953 Rawlings Company has been using a "Head Cushion" system of shock absorption in their helmets. This system is employed in either a head hammock suspension or a six point suspension (see PLATE XX, p. 36). Helmet manufacturers such as Wilson and Spalding have similar suspension systems.

The most popular football helmet manufactured today is the Riddell Helmet with its Safety Suspension (see PLATE XXI, below). This helmet features a hard kvarlite shell with

PLATE XXI.--Riddell Helmet. Note teardrop shape.

46"From Head Harness to Head Cushion", loc. cit.
a suspension system made of high tensil web strapping. The suspension is adjustable to various head heights, but headbands are made in exact sizes. When a blow strikes the shell, the force of the blow is distributed throughout the entire shell, then through the suspension.

Although plastic helmet shapes have varied between companies, the present trend is to use the teardrop shape (see PLATE XXI, p. 37). This shape has proved to be the best for deflection of blows from any angle. Whereas the first Riddell plastic helmet was somewhat flat on top (see PLATE XVII, p. 33), a blow on the crown of the helmet would have to be absorbed by the helmet. With the present teardrop shape helmet, the same blow might slide to one side or the other, thus the helmet would not receive the full magnitude of the blow.

Information gained by Bell-Toptex Incorporated in designing and manufacturing racing helmets and military flight helmets was used to develop a new type of football helmet in 1960 (see PLATE XXII, p. 39). This helmet, consisting of a fiber glass shell with a nonresilient liner made of expandable polystyrene and a slow-rebound comfort liner, has been utilized by the Hobbs High School football team of Hobbs, New Mexico, for the past four football seasons. In

PLATE XXII.—Bell-Toptex helmet consisting of a fiber glass shell, nonresilient (crushable) liner, slow-rebound comfort liner, fabric cover, rubber edge protector, and cheek and sizing pad.
tests by both Snively and Miller, this helmet performed better than the standard football helmets.

One can readily see that the football helmet has gone through many changes in the 72 years since its first use. There is little doubt that the development and improvement of the helmet has had a great deal of effect on the game as it is now played. One can only speculate what the game would be like today if a rule had been introduced during American football's infant years prohibiting the use of a head protector.

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48Snively, Kovacic, and Chichester, loc. cit.

49Miller, loc. cit.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Early head protectors worn by football players were often designed by the players themselves. The efforts of these players were influenced more by the desire to protect against external bruises and lacerations of the scalp, eyebrows, and the ears, than to protect the brain and its coverings. Design was influenced more by style, desirability of light weight, freedom of vision, and considerations other than those having to do with the effects of sudden acceleration and deceleration.

For nearly thirty-five years most helmets were constructed of leather with felt padding. During this period, coaches and athletic trainers had a great deal to do with helmet design. A leather helmet with a hard fiber crown, foam rubber padding, and web suspension was the construction that marked the 1930's and early 1940's. The plastic helmet became popular in the 1940's, and is the leader today.

It is interesting to note that only in the past decade has truly scientific research in headgear design and construction been used by helmet manufacturers.
CONCLUSIONS

It is the conclusion of this author that impressive strides have been made in optimum helmet protection; specifically, several leading sporting goods companies are employing the best engineering principles at hand in conducting research. Among these firms are the John T. Riddell Company and Bell-Toptex Incorporated.

RECOMMENDATIONS

The following recommendations are made by the author as a result of this study:

1. It is recommended that historical studies be made on all items of football equipment.

2. It is recommended that a continued effort be made by the National Professional Football Hall of Fame and the National Football Foundation and Hall of Fame to acquire all significant football memorabilia to the effect that future generations of American sports fans may have a better understanding of the history of American Football.
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