TRANSACTIONS

OF THE

TEXAS ACADEMY OF SCIENCE

FOR 1899,

TOGETHER WITH THE PROCEEDINGS FOR

THE SAME YEAR.

VOLUME III.

AUSTIN, TEXAS.
PUBLISHED BY THE ACADEMY.
OCTOBER, 1900.

TRANSACTIONS

OF THE

TEXAS ACADEMY OF SCIENCE

FOR 1899,

TOGETHER WITH THE PROCEEDINGS FOR THE SAME YEAR.

VOLUME III.

AUSTIN, TEXAS.
PUBLISHED BY THE ACADEMY.
OCTOBER, 1900.

COMMITTEE ON PUBLICATION.

James R. Bailey, Ph. D.,

Wm. L. Bray, Ph. D.,

Henry L. Hilgartner, B. S., M. D.

VON BOECKMANN, SCHUTZE & CO., PRINTERS, AUSTIN, TEXAS.

CONTENTS.

From the Standpoint of a Man of Science.

[*Annual Address by the President.*]

DR. FREDERIC W. SIMONDS.

[*Annual Address by the President, October 13, 1899.*]

FROM THE STANDPOINT OF A MAN OF SCIENCE.

DR. FREDERIC W. SIMONDS,
University of Texas.

We are living in a great age—the best, perhaps, the world has ever seen—the Age of Scientific Achievement. Compared with the present the past is darkness, or at most, illumined with a dim and feeble light. So marked is the contrast, notwithstanding the high civilization of Rome, Greece, Egypt and India, this, our day, is, by many, regarded as the beginning. If the beginning, what, we may well inquire, will be the end? That wonderful instrument, the human mind, fearless, penetrating, persevering, is wresting from Nature her closest secrets, which, classified and utilized under the name of Science, are of incalculable benefit to the world. Yet, strange as it may seem, by the public at large, and even in the more enlightened countries, Science, though a direct contributor to civilization and happiness, placing at man's disposal resources practically unlimited, is little understood and the Man of Science, at times, positively misunderstood. In this address it is my purpose to point out some of these misunderstandings and to illustrate by example, some of the differences between real science and what is popularly conceived to be science.

THE IDEAL SCIENTIFIC MAN.

At the outset, let me picture the ideal Man of Science. If he be scientific he must be honest—his work must be thorough and well done. Willing to plod, willing to wait—Truth is not an *ignis-fatuus* ever escaping from his hand, but a tangible thing, which, as a reward of patience and industry may, through him, be given to the world. Modest and unassuming, he may not proclaim his own fame from the housetop, he may not advertise his wares, he may not seek notoriety; but rather the quietude of his laboratory, the solitude of the wilderness, or, perchance the presence of death itself. His highest aim is not personal fame, but to add to human knowledge, to contribute something, though it be a mite, to the great fund of man's information, to leave posterity an inheritance of value.

QUACKS AND PRETENDERS.

But following in the footsteps of such a man is an army of quacks and charlatans—men who hesitate not to appropriate the work of others, men who keep themselves in the public eye until in a dazed and bewildered state, worthy folk are unable to distinguish between the true man and the impostor. And the public press, with shame I confess it, and even the dignified publishers of books, lend themselves to this deception. Think of an adventurer, with some patent nostrum or microbe annihilator advertising himself in company with Huxley or Helmholtz! Like a great tidal wave, the public seems to lag behind, and the appreciation showered upon "scientific frauds" is due not to real adoration, but to ignorance. He who can distinguish between the false and the true can not fail to be impressed with the genuine worth of the scientific men of the day; yet, how sharp the contrast, not infrequently thrust upon our view, when we behold the vast array of fraud and delusion pressing forward for the seats of honor, national, state, educational, pushing ruthlessly aside, it may be, their true occupants. This is a species of savagery still tolerated in many "civilized" communities, where in violation of all moral obligations, "might makes right"; but, as surely as darkness flees from light, so surely must these degenerate growths wither and decay under the scorching rays of the intellectual sun.

That shams exist we all know; that they are greater to-day than ever before may be questioned; that they are permitted to exist, when their true character and purpose is recognized, is a reflection—and it can not be construed otherwise—upon the morals and integrity of the people. If the masses be ignorant, it is the duty of the few who know to teach them, though the blare of the brazen may attempt to drown modest worth. Truth, and Truth only, is destined to survive. Untruth, though its followers number legions, will surely perish, but not in our day and generation; therefore, it behooves every educated person to consider well the banner he follows, whether it be that of Truth or that of Sham; whether that of the rabble jeering at true worth, or that of the earnest seekers after knowledge.

THE MEDICAL PROFESSION.

To be specific: From the standpoint of the Man of Science, the searcher for truth, the advocate of truth, public indifference to fraud is pitiful. For years in many of our states the practice of medicine, for example, has been poorly regulated, or practically not regulated at all. The veriest ignoramus, the owner of a "bogus diploma," the graduate of a "six weeks' course,"[1] or a course of "home study," is free to enter upon a career—can it be termed other than a career of imposture and crime? The inability of our law-making bodies to handle the question of medical practice is well nigh incomprehensible, especially when the responsibilities of no profession exceed those of the medical profession. That one's life, or the lives of those dearest to him, should be innocently placed in the hands of a charlatan is horrible to contemplate; yet legislators, with an eye more to their own glory than the welfare of their constituents, allow the crime to run its course year after year, making no attempt to stem or even check the current. The fact is, the public fails to distinguish between the pretender and the scholar. Fine dress, easy manners, an elegantly furnished office, in short, *show* is mistaken for knowledge. A glib tongue does not indicate necessarily a skillful surgeon—it may indicate a consummate knave—but he must have a steady, well-trained hand, guided by a thorough knowledge of anatomy. If the accumulation of a fortune be an index of success, then has many a "quack" been successful; but the same is true of many another wicked and immoral person judged by the same standard. Sooner or later the pretender is unmasked by those who see him in the true light, and branded as a "fraud," he is to the great body of truthseekers forever an alien—an outcast. Still the public fails to realize the seriousness of the case, and frequently, it is only after repeated exposures of malpractice that the charlatan is finally dethroned.

THE POLITICAL APPOINTEE.

Again, with indignation, the Man of Science beholds the competent, scholarly man, the specialist, the enthusiast in his chosen field "turned down and out" to make place for the so-called "political appointee." I call to mind in my own profession, geology, the dismissal of a most competent and highly trained state geologist for the purpose of making "room" for one totally ignorant of the first principles of the subject. "Brawn" and "pull" may be temporarily triumphant, but what of truth can such an one give the world? Well may we blush with shame that in these "days of scientific achievement," the last days of the Nineteenth century, in the "best age the world has ever seen," such an act of vandalism is tolerated by a free people. This is but a single instance, yet it well illustrates the fact that to the wicked all things are unholy—to the

[1] As bearing upon this statement, attention is called to the following advertisements clipped from a well known Texas daily paper:

I. "How soon graduate medicine, dentistry, law, pharmacy, osteopathy, electrology. Box ——, ————, Ill."

II. "Hypnotism, ocultism, magnetic healing taught by mail. Free lessons. Dr. ————. ———— Ave., ————, Ill."

profane not even Truth itself is sacred. That such an act is deliberate need not be questioned—for the greed of power some men would sell their birthright. The want of a prompt and vigorous protest on the part of the community, however, is due not so much to an acquiescence in what has been done as to a misconception of what Science really is and what the Man of Science is attempting to do. A highly cultured musician, no doubt, would feel greatly aggrieved at the thought of his profession being judged by a few strains from a "catchy tune" whistled on the street; yet this is the kind of treatment not infrequently accorded the Man of Science. A few showy experiments, amusement for the people, serve to fix the public estimate of his profession, while his profounder work is passed slightingly by, misunderstood, and, it may be, misrepresented. From this point of view we can readily understand how it is possible for the unprincipled politician to foist upon the public an "appointee" totally unqualified for his position and worthless, or worse than worthless, in his relations to science. Think for a moment what this means; in our great cities, for instance, meat inspectors, milk inspectors, sanitary inspectors, health officers are appointed at the dictum of that petty tyrant, the ward politician. The spectacle often presented is that of a municipality pretending to protect itself by playing with science—an insult to the very name. Now, I do not wish to be misunderstood; I am aware that not all political appointments are of this kind. Scientific bureaus, national, state and municipal, are in these days a necessity, and when properly administered, of immense value to the people; but when their work is a mere travesty of science they are tolerated only because of public ignorance, or a low moral standard; for I maintain that the upholding of deception—of fraud—when known to be such, by an individual, a community, a state, or a nation, shows decided and marked obliquity.

AN "ISM" NOT SCIENCE.

Science is the child of Truth. Broadly speaking, it may embrace all branches of learning that admit of "the scientific method of treatment." *Proof must crown speculation*—an "ism" is therefore not science. A matter of belief is one thing; science is another. There are those who believe in "occultism," in "spiritualism," in "Christian Science," in "mesmerism," in "hypnotism," etc., but the explanations offered by them can not be regarded as scientific, for they do not employ scientific methods of investigation.[2] An "ism" may have a numerous following; its advocates may even be regarded as scholarly, but obviously their strength

[2]To be convinced that "Christian Science" is not science, one needs but read Dr. J. B. Huber's article in the October, 1899, number of Appleton's Popular Science Monthly, in which he describes his futile attempts to secure satisfactory answers to a series of questions bearing upon medical and surgical treatment as

does not lie within the domain of science. When mental phenomena is the subject of study, the most delicate tests are essential; the veil of darkness, of mystery, must be torn aside, and every safeguard employed against deception, be it willful or otherwise. And, I may add, under no circumstances is a people more easily duped than at the hands of a skilled advocate of an "ism" who poses before them as "scientific."

MISCONCEPTION OF THE PUBLIC.

Again, the occasions are not few when the Man of Science feels that he is personally misunderstood by the public. While he is attempting to do one thing, another, and a totally different thing, may be expected. All science is not applied science. That a man should labor early and late without the hope of financial reward, that science for the sake of science should be an incentive, is utterly beyond the mental grasp of some selfish individuals. Were the "scientific spirit" a burning flame in the midst of darkness they could not see it. For such the only hope is that, by careful education and patience, their children's children, at least, may see the brightness of the day!

But let us look into the matter more carefully, analyze the situation more minutely. Whether science be understood or not depends in a great degree upon environment. Let me illustrate: If a people be remote from the great centers of scientific activity and growth; if its thought tends towards other than the scientific aspects of life; if its opportunities for advancement are confined to one or a few channels, as law, politics, theology and the like, the breadth of its culture is limited, the old ideals have not yet given way to the new, and, in consequence, its scientific progress is an exceedingly slow, and, perhaps, stunted growth. With such the misconception of science is most marked. That similar misconceptions may occasionally appear under other environmental conditions is not denied. My reference here, however, is not to the profoundly ignorant, but to the so-called "educated" classes.

THE WORK OF THE CHEMIST.

Take, for instance, the chemist. Many associate him with a "druggist," an apothecary. Others regard him merely as an analyst, who, by the application of some "rule," is able to ascertain the ingredients of a mixture. That he should investigate in other lines is unknown to them; that in the domain of matter his discoveries should be of the highest type

practiced by Christian Scientists. Mrs. Eddy referred his courteous letter to her attorney, Judge Hanna, who, in his answer, appears to have accomplished but one thing in a satisfactory manner, and that was to "stave off" a reply to the questions.

is undreampt by them. Yet, it is true that the chemist is not a mere "rule of thumb" experimenter, an analyst who follows blindly the receipts of others, but, on the contrary, an investigator; indeed, he may be an investigator in the most exalted meaning of that term, ever on the lookout for new elements, and, what is of more importance, new combinations of elements; and higher still, it may be his privilege to assist in unraveling the skein, which, in its tangled meshes, conceals some of the profoundest laws that govern the universe. What of dollars and cents in this aspect of his work? Is it honor and glory he seeks? Such may be his reward, and, if so, he merits them. Little does the public know of the inner life of the investigator, and few recognize the severity of his self-imposed task. An eminent factor in the world's progress he may be, yet, so modest in demeanor, so unassuming in manner, so devoid of self-consciousness, that even his associates may, for a time, be unaware of his greatness.

THE WORK OF THE GEOLOGIST.

The geologist, too, in many communities is misunderstood, and even in states where his function ought to be as well known as that of the preacher or schoolmaster. To ordinary eyes he figures as "a collector of rocks, fossils and minerals." Beyond the building up of a cabinet, public knowledge seldom goes. How often we hear it said that "Mr. So-and-So must be a fine geologist; he has a beautiful cabinet." Now the making of a cabinet may be the work of the merest novice. There are "fiends" in all walks of life; photograph fiends, postage stamp fiends, autograph fiends—persons who gloat over a collection of any thing, not that it is of any special value or use to them, but theirs, a possession. The geologist is not at all of this type. If he collects rocks, fossils, and minerals, rest assured it is for some purpose. Rocks assist him in interpreting the earth's history, and, at times, are especially valuable from an economic standpoint, for his knowledge of their association and relation may be worth thousands of dollars to a community directly, or indirectly in preventing useless expenditure in the vain search for something that does not exist. The fossil contents of rocks not only enable him to recognize strata, but they give him an insight into the great problem of the earth's population; the evolution of forms, the migration of faunas, the succession of faunas and floras in time—questions of the keenest interest, questions requiring extended and minute research. That species must be named and described is true; but, beyond all this is the great philosophic inquiry regarding the origin of life and the development of living things. Whatever answer is received must come largely through this channel. Not only this, but the answers to many of Nature's problems will only come—can only come—after a patient, painstaking study of fossils and rocks. A "cabinet fiend" a geologist! Never did public opinion shoot wider of the mark.

Again, there are certain persons who confuse a geologist with a chemist, assayer, mining engineer. Now, while he may know much or little of the branches which they represent, professionally, he occupies a different field. It is admitted, of course, that occasionally, sometimes frequently, problems arise in which outside knowledge is a necessity, and especially that of chemistry. That this should be so need cause no surprise, for geology, be it remembered, is a composite science, which, in various directions, merges—blends—with other lines of research.

THE SPECIALIST AND APPLIED SCIENCE.

A geologist may be an "expert," using this vague term to indicate a specialist in some particular field, as an "expert in oil," "in natural gas," "in coal." Here his knowledge is of great practical value, and *pure* science gives place to *applied*. Thus, economic geology becomes an agent for the acquirement of wealth, and is, therefore, of no little importance in the development of the world's material resources.

In some communities the function of a geologist is confused with that of a "prospector." Those who have served on state geological surveys will recall the oft-repeated interrogatory: "Mister, are you looking for mineral?" While the geologist is not prohibited from prospecting, nor even from assaying, if he chooses to do so and is competent, he rarely makes it his sole object. When, however, called upon professionally, he will undertake investigations in economic geology, and, when so engaged, he is entitled to the same substantial consideration as is given the professional experts in other fields of applied science, such as civil, mechanical or electrical engineering. Here is a difference which the public fails to understand: In pure science the worker is free to give to the world the truths gleaned from Nature; but, when the domain of applied science is entered, the information sought becomes a matter of sale, and should be paid for as any other commodity. When the commercial world desires special investigations, as in chemistry, physics, geology, botany, etc., for the purpose of financial gain, then the years of study and training, the experience of the Man of Science, must be recognized as capital, and as such should have an "earning capacity." There is no injustice in this; surely intellectual possessions are the most valuable of all possessions, and ought they to be reckoned of less worth than stocks and bonds, warehouses, machinery and goods! This the public must concede.

TEACHERS OF SCIENCE.

In our educational institutions where one would expect to find an earnest, nay, an ardent support of science, we frequently find the reverse. In the smaller and meagerly endowed schools, normal schools and colleges, and even in institutions bearing the name of "University," it often happens that the studies of several departments are assigned to a single professor. That a "professor of the natural sciences," for example, can teach effectively or efficiently the studies comprehended in his title is out of the question—it is a physical impossibility. He is over-worked; he can not even keep abreast of the times; fresh lectures are not to be thought of; and, no matter how ambitious he may be, he is compelled to enter upon the text-book phase of teaching. In the meantime, what of laboratory instruction so essential in modern scientific training? When will our administrative officers, trustees, presidents, principals, recognize the fact that long hours kill inspiration, destroy originality, and that overwork reduces a teacher to a mere machine? And further, when will they recognize the fact that science can not be properly taught without adequate equipment, a suitable library, apparatus, collections and laboratory facilities? Memorizing a text-book can scarcely be called studying science, and the officers of an institution who belittle laboratory methods, or ignore them as unessential, perpetrate a great wrong upon their students. In short, the moral right of an institution to undertake instruction in science without providing proper appliances may be questioned, and its administrative officers are guilty of fraud, for they profess to do that which they can not do. But the mischief does not end here. Plastic minds may be moulded, conceptions, or rather misconceptions, of truth impressed upon them which the experience of a lifetime may not eradicate. It should be made plain that an adequate provision for instruction in one branch of science is worth infinitely more to students than a superficial attempt at instruction in several without proper equipment.

On the other hand, the larger the institution, the greater its endowment and consequently its income, the broader its officers of government, the stronger the assumption that the instruction offered will be of high grade. As such an institution can afford specialists in its different departments, the instruction will be deeper and richer, more thorough, and, may I say, more truthful. When the opportunity is given the teacher or professor to devote his time and energy to a limited field there will be felt an inspiration in the work, an enthusiasm, which, consciously or unconsciously shared by the students, becomes an incentive of the highest order in awakening interest in scientific investigation and research.

THE UNIVERSITY PROFESSOR AND ORIGINAL RESEARCH.

That an opportunity be afforded him to carry on original investigation is the chief desire of a university professor. Success in this direction gives him a reputation which, in no small degree, is shared by the institution he serves. Yet he must recognize the fact that his first duty is to his students—they demand and they receive his energy, his time, his best thought. Whatever of research is done must be the work of spare moments, time, it may be, stolen from his periods of rest. The character of the work undertaken depends, too, upon the facilities offered by the institution. In different parts of our country, and even in the best universities, these vary greatly, but, no matter how great the facilities offered of a material kind, there is one thing that can effectively stifle investigation, and that is overwork. The trustees and even the presidents of many institutions fail to recognize that university work is exhaustive work, and especially in the line of science. A man can not labor in the class room and laboratory all day, prepare lectures at night, and successfully carry on outside investigations. While it is true that the professors in Northern and Eastern universities are the more productive, the reason is not far to seek; not only have they better facilities, but they have more leisure. I believe that trustees and presidents are at times over-exacting; they expect productivity, publication and research by the professor, when, on their part, the possibility of such work is not encouraged in any substantial manner. That they mean well in their official connection with universities need not be doubted—the difficulty, in most instances, is that, educated in other than scientific lines, members of the governing boards fail to understand that a scientific paper, involving research, may not be written as readily as a lawyer writes his brief or a preacher his sermon. Time and facility—granted that there be ability and training—are needed by most men to produce results worthy of publication. Personally, I believe that research is a part of university work, and that it should be fostered in every conceivable and possible manner. I feel, also, that I am in no wise apologizing for my profession in plainly stating the facts. The trustees and executives of our institutions of learning should fairly meet the issue: that more investigation is not carried on and more worthy publications made is not altogether the fault of the professor. As I know them, university instructors are conscientious men who fully realize their responsibilities which are first of all to their students. If boards of trustees would make even limited provision for research by suitable appropriations, improved facilities, and less exacting duties, the productivity of what now seems barren ground would, I venture to say, be astonishing.

OUR DUTY.

I have spoken of the ideal Man of Science—of his ambition to add to the great fund of human learning; I have spoken, too, of the charlatan who would bedeck himself with the garlands won by others; I have pointed out some of the misconceptions of the public and the evil consequences following, as exemplified by reference to medicine, chemistry, geology; and I have shown the calamitous results attendant oftentimes upon political appointments; I have dwelt especially upon the popular misunderstandings of science for the reason that the attention of the public should be emphatically called to them; I have briefly considered science in its educational aspect for a three-fold purpose: First, to correct the impression that science can be taught without equipment; second, to emphasize the high ambition and lofty aims of teachers of science; and third, to correct an opinion more or less prevalent in governing boards that the university professor is unproductive from choice, that he is content to teach "for wages as a laborer." That we have a duty to perform is evident. As Men of Science we are to ever stand boldly—aggressively, if need there be—for the truth. To this end we must exert ourselves in every legitimate way to create a proper and wholsome scientific spirit among our people. Error must be exposed and misunderstanding corrected. The blare of the brazen is not science; the pretender is not genuine; misunderstanding is not reality!

A Record of the Geology of Texas for the Decade Ending December 31, 1896.

FREDERIC W. SIMONDS, Ph. D.,
PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF TEXAS.

A RECORD OF THE GEOLOGY OF TEXAS FOR THE DECADE ENDING DECEMBER 31, 1896.

FREDERIC W. SIMONDS, Ph. D.,
Professor of Geology in the University of Texas.

(Publication authorized February 3, 1899; presented to the Academy June 12, 1899.)

PREFATORY NOTE.

This Record of the Geology of Texas supplements Bulletin No. 45 of the United States Geological Survey ("The Present Condition of Knowledge of the Geology of Texas," by Robert T. Hill, Washington, 1887). Doubtless its imperfections are many, nevertheless, it will serve as a guide to those who desire to know what, where, and by whom, work has been done in the past ten years—a decade especially fruitful in results. The many papers of value produced by my predecessor, Professor Hill, now of the U. S. Geological Survey, and by the Geological Survey of Texas (Dumble Survey) are embraced within this period. Broadly speaking, our knowledge of Texas geology may now be said to rest on a firm foundation—details are yet to be worked out; errors corrected.

The libraries of the University of Texas and of the lately discontinued Geological Survey, as well as my own, have been carefully gone over, and in addition I have drawn freely upon the work of others, of which I wish here to especially mention the excellent Records of Mr. N. H. Darton, of the U. S. Geological Survey (Bulletins Nos. 75, 91, 99 and 127), and the valuable Bibliographies and Indexes of Mr. F. B. Weeks, also of the U. S. Geological Survey (Bulletins Nos. 130, 135, 146 and 149).

With few exceptions contributions to newspapers are not included, as they are usually inaccessible, and the matter is found in a more permanent form elsewhere.

Frederic W. Simonds.

School of Geology, University of Texas, 1897.

A delay in printing this Record has enabled me to add much that would otherwise have been omitted. I desire here to express my obligations to Mr. E. T. Dumble, lately State Geologist, for information that has been

freely given, and to the Hon. Jefferson Johnson, Commissioner of Agriculture, Insurance, Statistics and History, for courtesies shown me while prosecuting the work. To Professor Robert T. Hill, of the United States Geological Survey; Professor Gilbert D. Harris, of Cornell University, and to Mr. W. Kennedy, of Austin, I am greatly indebted for publications unknown to the ordinary reader, and not easy to obtain. My thanks are also due Librarian Wyche, of the University, both for suggestions and valuable assistance. F. W. S.

December, 1899.

Publications marked with a star (*) have not been examined by the Compiler.

LIST OF AUTHORS WHOSE PAPERS ARE CITED IN THIS RECORD.

ADDITIONAL CITATIONS.

PUBLICATIONS RELATING TO THE GEOLOGY OF TEXAS, 1887-1896 INCLUSIVE, ARRANGED ALPHABETICALLY ACCORDING TO AUTHORS.

---

1. ALDRICH, T. H.

A New Eocene Fossil from Texas.

The Nautilus, Vol. IV, No. 3, p. 25. Phila., July, 1890.

Description of *Omalaxis Singleyi* n. sp. Locality: Lee County, Texas. "This is the second species now known from the Atlantic Eocene. The first was described by I. Lea from the Claiborne sand as '*Orbis rotella.*' For the generic synonomy, see Dall's 'Report on the Molusca,' 1889, part 2, p. 276. Discovered by J. A. Singley, Esq., and named in his honor."

2. ————

New or little known Tertiary Mollusca from Alabama and Texas.

Bull. Am. Paleontology, Vol. I, No. 2, 30 pp., pls. 1-5. Ithaca, N. Y., June, 1895.

"The fossils described in this paper were obtained by the writer between the years 1887 and 1889, and the plates and most of the descriptions were prepared for publication early in 1890. The material, however, was never published, and since then several of the forms illustrated have been described by others. A large number of the species are from the Eocene of Alabama. They do not by any means exhaust the subject, as the writer still has a number of new species from the prolific strata of Alabama and adjoining States.

"Through the kindness of Professor Gilbert D. Harris, of Cornell University, the writer is now able to publish the following descriptions.

"All the types of the species herein described are in my collection unless otherwise stated." P. 3.

Only forms occurring in Texas are included in the following list:

Scaphopoda: *Cadulus juvenis*, Mr., Mosley's Ferry, Burleson county; Lee county. Pteropoda: *Creseis simplex ?* Mr. Gastropoda: *Borsonia* (*Scobinella*) *conradiana* n. sp., Wheelock, Tex. *B. plenta*, Har. and Ald., Wheelock and other localities; *Eucheilodon reticulata*, Gabb, Wheelock; *Glyphostoma harrisi* n. sp., Wheelock, also Lee and Burleson counties; *Pyramimitra costata*, Lea, Texas; *Pyrula* (*Fusoficula*) *texana*, Harris, "occurs at Newton, Miss., Lisbon, Ala., and Texas." *Goniobasis texana* Heilp., Wheelock and Lee County, Texas.

3. AMERICAN NATURALIST.

The Tertiary Formations of Western Texas.

Vol. XXV, p. 49, Jan., 1891.

A general note referring to the work of Prof. R. T. Hill. (Notes on the Geology of Western Texas, Geol. and Sci. Bull., Oct., 1888; The Geology of the Staked Plains of Texas, with a Description of the Staked Plains

AMERICAN NATURALIST.

Formation, Proc. Am. Assoc. for the Adv. of Sci., Vol. XXXVIII, p. 243; Classification and Origin of the Chief Geographic Features of the Texas Region, Am. Geol., Vol. V, pp. 9-29.) Reference is also made to Dr. Otto Lerch (A Geological Survey of the Concho Country, Texas, with Cummins, W. F., Amer. Geol., Vol. V., pp. 321-335), and to Prof. E. D. Cope (On the Distribution of the Loup Fork Formation in New Mexico, Proc. Amer. Phil. Soc., 1883, p. 308).

4. ————————

Occurrence of Texas Lignite
(General Note.)
Amer. Naturalist, Vol. XXV, p. 737, Aug., 1891.

A paragraph, very slightly modified, taken from Lerch ("Lignites and their Utilization, with special reference to Texas Brown Coal," Second Ann. Rep. of the Geol. Surv. of Texas, pp. 52-53. 1891).

5. ————————

The Iron Ore District of East Texas.
Vol. XXV, pp. 910-911, Oct., 1891.

A general note referring to the account of this region given by Mr. E. T. Dumble, State Geologist, in the Second Annual Report of the Geological Survey of Texas, 1890, pp. 7-31.

6. ————————

Fresh-Water Diatomaceous Deposit from Staked Plains, Texas.
(General Note.)
Vol. XXVI, pp. 505-506. June, 1892.

"Some nearly white earth, very light in weight, from Crosby County, Texas, and within the Staked Plains region was submitted by Prof. E. D. Cope to the first of the undersigned authors for examination. [Mr. Woolman.]

"In a contribution to the 'Vertebrate Paleontology of Texas,' p. 123 of the Proceedings of the American Philosophical Society [Vol. XXX], Prof. Cope states that this material is from the Blanco Cañon beds as named by Mr. Cummins in the first annual report of the Geological Survey of Texas, 1890, p. 190, and describes it as a 'white siliceous friable chalk.'

"Under the microscope this earth is found to be constituted almost entirely of the siliceous skeletal remains of fresh-water diatoms, probably 90 per cent. of the body of the earth being made up of these minute single celled forms of plant life." * * *

Mr. C. Henry Kain reports: "This is a fresh-water fossil deposit. The species contained in it may now be found living in Utah and in the Yellowstone National Park. Many of the species are also common to fresh water streams everywhere."

A list of twenty-seven identified species follows, signed by Lewis Woolman and C. Henry Kain.

"In the paper previously referred to, Prof. Cope notes the occurrence in this diatomaceous stratum of a 'Mastodon of the angustidens type,'

AMERICAN NATURALIST.

and of a horse allied to the *Equus occidentalis* of Leidy, and defines the latter as a new species, to which he assigns the name *Equus simplicidens;* and indicates by a comparison of Equus and Mastodon fauna that the age of the Blanco Cañon beds is probably intermediate between that of the Equus beds and the Loup Fork beds or the equivalent of the Pliocene proper."

7. ASHBURNER, CHARLES A.

Art. Coal. Min. Resources of the U. S. 1886. (Coal in Texas), pp. 347-350. Washington, 1887.

Outline: Production and value, 1886. E. T. Dumble quoted on boundaries of Eolignitic Area; number and thickness of seams; quality and use of lignite; attempts to utilize it as fuel. Analyses of Texas lignite. Mr. Dumble quoted on lignite at Rockdale, Milam County, and Atascosa, Bexar County. Location of Central Area. Hon. S. H. Stout, of Cisco, quoted. Mountain Area, along the Rio Grande and between that river and the Pecos. Geological relations of the beds. Thickness of seams near Laredo. Hon. W. M. Chandler quoted on coals west of the Pecos. Analyses of lignite by Dr. Edgar Everhart.

"Total production in 1886, 100,000 short tons; spot value, $185,000. (The same figures are given in table showing the 'Production of coal in the United States in 1886,' p. 230.) No reliable statistics of the amount of coal mined in this State are available." P. 347.

"The following analyses of lignites from different points in Texas have been supplied by Dr. Edgar Everhart, Professor of Chemistry at the University of Texas:

ANALYSES OF LIGNITES FROM DIFFERENT POINTS IN TEXAS.

LOCALITY.	Fixed Carbon.	Volatile Matter.	Ash.	Water.	Total.	Sulphur.
Lignite from Robertson county	29.34	44.89	9.91	15.86	100.00	......
Lignite from Cherokee county	28.75	18.80	36.03	16.42	100.00	......
Lignite from Milam county	30.65	45.17	5.39	18.79	100.00	1.04
Lignite from Hopkins county	21.66	50.28	5.14	22.92	100.00	0.67
Lignite from Northwest of Texas	36.87	43.40	3.25	16.48	100.00	0.75
Lignite from North Texas	40.77	31.11	7.66	20.46	100.00	1.82
Do	37.19	30.98	14.06	17.77	100.00	2.36
Do	42.03	29.66	12.43	15.88	100.00	2.90
Semi-bituminous coal from Burnet County	43.03	38.97	13.62	4.38	100.00	4.14
Do	40.40	39.89	15.58	4.13	100.00	5.22
Coal from Palo Pinto county near Gordon	63.64	32.64	2.86	0.86	100.00	0.25

8. ————————

Art. Coal. Min. Resources of the U. S. 1887. (Coal in Texas), pp. 357-359. Washington, 1888.

Outline: Production and value, 1887. Thickness, depth of seams and quality of coal at mine of the Black Diamond Coal Company, near Rockdale, Milam County. The Kirkwood Colliery. Thickness of the bed. Mine operated by R. H. Hartz near Eagle Pass, Maverick County. Thickness of beds. Extent of adjacent coal field.

ASHBURNER, CHARLES A.

"Total production in 1887, 75,000 short tons; spot value, $150,000.

(See also table 'Production of Coal in the United States in 1887,' p. 171, of the same volume.)

"No reliable statistics of the amount of coal mined in this State are available." P. 357.

"The largest mine in the State from which returns were received by the Survey was that operated by Mr. R. H. Hartz, at Eagle Pass, Maverick county. This mine produced during the year 22,700 tons, including nut and slack coal. Of this production, 17,400 tons were shipped to San Antonio or supplied to the Southern Pacific Company for locomotive use. This coal commanded in 1887 a price of $2.25 per ton at the mines. The coal is used for stationary engines and locomotives. The bed worked is 6 feet 4 inches in thickness, and is interstratified with a streak of slate, which reduces the workable thickness to 4 feet 3 inches. The coal is hard, and has to be blasted with powder. The coal field in this vicinity is very large; its exact dimensions have never been established, but the outcropping of coal beds can be seen for miles up and down the Rio Grande river in the vicinity of Eagle Pass. The mine operated by Mr. Hartz is about 5 miles northwest of Eagle Pass." P. 358.

9. ——————

Art. Coal. Min. Resources of the U. S. 1888. (Coal in Texas), pp. 367-374. Washington, 1890.

Outline: Production and value, 1888. Location of the more prominent mines of the State (Carboniferous and Cretaceous). Texas and Pacific Coal Company. The Spring Mine, 110 miles east of El Paso. Thickness of seam and depth below the surface. Preliminary report of E. T. Dumble, State Geologist to the U. S. Geol. Surv.: Three coal fields. (1) Central Coal Field, Carboniferous, bounded. Dr. Charles A. Ashburner on the coal-bearing strata. (2) Nueces or Semi-bituminous Field, bounded. Number and age of seams. Where worked. Character of lignites. (3) Lignitic Field, bounded. Number and thickness of seams. Carboniferous formation of North Texas. Boundaries. Thickness. Counties embraced in the true coal measures. Number and thickness of seams. Section of coal-bearing strata near Millsap. Information concerning the following mines (location, thickness of seams, etc.): Gordon, Palo Pinto county; Johnson, between Gordon and Strawn; at Cisco; outcrop east of Putnam; ten miles west of Decatur; Stephens, four miles west of Bowie. R. A. F. Penrose on lignites of Eastern Texas: number and thickness of beds. Character of lignite. Outcrops in Van Zandt county; along the line of the Texas and Pacific. Prof. Gustav Jermy reports deposits in southwestern counties. Col. John L. Tait reports lignite in Edwards, Bandera, Medina, Atascosa and Frio counties. Outcrop fourteen miles southwest of Uvalde; thickness. The western boundary of this field. Coal seam at Eagle Pass. Extent of outcrop. Inclination of stratum. Thickness in Hartz mines; character and stratigraphical position.

"Total product in 1888, 90,000 tons; spot value, $184,500. On account of the very scattered and meagre developments of the coal and lignite beds of Texas it has been impossible to collect any reliable statistics as to the

ASHBURNER, CHARLES A.

product during 1888 at each point where these beds have been opened." P. 367.

See E. T. Dumble (Coal in Texas). Mr. Dumble's report is included in Mr. Ashburner's article.

10. BIRKINBINE, JOHN.

Art. Iron Ore Mining in 1887. Min. Resources of the U. S. 1887.

(Iron in Texas), pp. 51-52. Washington, 1888.

"A large area of northeastern Texas exposes limonite ore which is of excellent quality. The deposits do not indicate great depth, but their liberal distribution would suggest quantities sufficient to maintain iron industries. Two blast-furnace plants now depend on these ores, one being operated in connection with the State penitentiary. Estimated upon the production of pig iron in 1887, the amount of these ores mined was about 9,000 long tons. The following analyses show the composition of the ore near Alcalde furnace:

COMPOSITION OF LIMONITE NEAR RUSK, CHEROKEE COUNTY, TEXAS.

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Iron	46.55	45.55	45.17	40.63	48.31	48.11
Silica	17.53	17.67	20.36	23.84	16.62	10.43
Sulphur	....	....	0.038	0.01	0.027	....
Phosphorus	0.153	0.069	0.062	0.315	0.284	2.12
Water	....	13.09	15.25	15.76	13.71	14.64

"A sample personally collected in Cherokee county was analyzed by the St. Louis Sampling and Testing works with the following results:

ANALYSIS OF LIMONITE FROM CHEROKEE COUNTY, TEXAS.

	Per cent.
Moisture	1.63
Loss by ignition	11.65
Silica	10.81
Alumina	3.40
Metallic Iron	48.24
Manganese	0.43
Lime	0.24
Magnesia	Trace
Sulphur	1.176
Phosphorus	0.268

"Exploration has been active in Llano county, about 90 miles northwest of Austin, where, at an elevation of 1,000 feet above the ocean, a deposit of red hematite iron ore has been exposed along a chain of hills running northwest and southeast. The iron formations crop out prominently throughout the valley, mostly in the quartzite belts. On the table lands and ridges mica schist, ferruginous sandstones, black shale, and tilted veins of slate are encountered at various places. Outcroppings are reported as numerous and indicating large bodies of ore. Samples of the ores submitted to Mr. Davenport Fisher, and one to the North Chicago Rolling Mills, show as follows:

BIRKINBINE, JOHN.

ANALYSES OF HEMATITE IRON ORES FROM LLANO COUNTY, TEXAS.

Iron.	Silica.	Phosphorus.	Manganese.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
63.25	6.35	0.049	Trace.	None.
67.43	4.03	0.059	Trace.	Trace.
66.27	2.81	0.47	Trace.	Trace.
68.26	....	....	....	....
68.82	2.52	0.038	Trace.	Trace.
69.30	3.83	0.034	Trace.	None.
70.95	2.89	0.024	Trace.	Trace.
67.54	2.45	0.041	None.	None.
69.17	2.99	0.009	None.	None.
60.49	15.67	0.020	Trace.	None.
50.99	26.05	0.019	None.	None.
63.74	10.08	0.018	None.	None.
67.27	4.83	0.018	Trace.	None.
70.25	1.23	0.014	Trace.	None.

11. ————

Reports on the Iron Ore District of East Texas. Part II. Fuels and their Utilization. Chapter I. Charcoal Manufacture in Texas.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 33-37. Austin, 1891.

The existence of iron ores in the State directs attention towards the possibility of smelting them within its boundaries. No immediate prospect of obtaining suitable mineral fuel. Charcoal suggested. The yellow pine furnishes excellent charcoal, as do also the hard woods of Eastern Texas. Should the timber be thus used the necessity of reforestration is pointed out. Manufacture of charcoal. (A) Charring in Pits or Meilers. (B) Charring in Kilns. (C) Retort Charring. Charcoal made under dirt covers and in kilns. Charcoal manufactured in Michigan; in Alabama. By-products. Economy of production. Form of kiln or retort for Texas. Cost of production.

12. ————

Art. Iron Ores. Min. Resources of the U. S. 1889-90.

(Production of Iron in Texas), pp. 35-36.

(Production of Brown Hematite in Texas), pp. 40-41. Washington, 1892.

The following, relating to the Iron Production of Texas, is taken from a table (pp. 35-36), showing the "Production of iron ores by States in 1890, 1889, and 1880, with percentages of increase or decrease:"

State.	1890.			1889.			1880.		
	Rank.	Production.	Per cent of total.	Rank.	Production.	Per cent of total.	Rank.	Production.	Per cent of total.
Texas....	21	22,000 long tons.	0.14	20	13,000 long tons.	0.09	19	3,214 long tons.	0.05

BIRKINBINE, JOHN.

The following is taken from a table (pp. 40-41), showing the "Production of brown hematite ore, by States, in 1890, 1889, and 1880, with percentages of increase or decrease:"

State.	1890.			1889.			1880.		
	Rank.	Production.	Per cent of total.	Rank.	Production.	Per cent of total.	Rank.	Production.	Per cent of total.
Texas....	15	22.000 long tons.	0.86	15	13,000 long tons.	0.51	15	3,214 long tons.	0.17

"Texas has commenced the development of its bog ores, but it is not probable that it will reach a production equivalent to 1 per cent. of the country's total for several years." P. 38.

13. ———————

Art. Iron Ores. Min. Resources of the U. S. 1891. (Iron Ore Product in Texas), p. 12. Washington, 1893.

From a table showing "The iron ore product of the United States in 1891, distributed by classes and States:

States.	Red Hematite. Long tons.	Brown Hematite. Long tons.	Magnetite. Long tons.	Carbonite. Long tons.	Total. Long tons.
Texas.......	....	51,000	....	....	51,000

"Texas' advance is due to the starting up of new blast-furnace plants, the mining having been principally in the brown hematite deposits in the eastern part of the State. As, however, railroads have reached the southern central portion of the State, where richer ores are found, it is probable that Texas will in the future augment her output and improve the average grade of her iron ores." P. 27.

14. ———————

Art. Iron Ores. Min. Resources of the U. S. 1892. (Production of Iron Ore in Texas), pp. 26 and 34. Washington, 1893.

In a tabulated statement on p. 26, Texas is credited with the production of 22,853 long tons of Brown Hematite, and 50 long tons of Magnetite during the year 1892, making a total production of 22,903 long tons.

On pp. 34-35, it is noted that "the brown hematite ores of Texas came from the eastern and south central portions of the State, the magnetite being a few car-load lots which were sent from the Llano district for trial in the blast furnace."

15. ———————

Art. Iron Ore. Min. Resources of the U. S. 1893. (Production of Iron Ore in Texas), pp. 26 and 28. Washington, 1894.

BIRKINBINE, JOHN.

Texas is credited with the production of 22,620 long tons of brown hematite and 3,000 long tons of magnetite for the year 1893; total, 25,620 long tons. P. 26.

In a tabulated statement, on p. 28, Texas is credited with the production of 13,000 long tons of iron ore in 1889; 22,000 in 1890; 51,000 in 1891; 22,903 in 1892; and 25,620 in 1893.

16. ——————

Art. The Production of Iron Ores in Various Parts of the World. Min. Resources of the United States. 1894.
16th Ann. Rept. U. S. Geol. Survey, Part III.
(Production of Iron Ore in Texas), p. 192. Washington, 1895.

In a table showing the production of different varieties of iron ore in the year 1894, by States, Texas is credited with 15,361 long tons of brown hematite.

17. ——————

Art. Iron Ores. Min. Resources of the United States. 1895.
17th Ann. Rept. U. S. Geol. Survey, Part III.
(Production of Iron Ore in Texas), pp. 26, 27, 41. Washington, 1896.

In a tabulated statement on p. 26, in which the production of iron ores by States, from 1889 to 1895, is given, Texas is credited with 8,371 long tons for 1895. This statement is repeated in a table on p. 27, and also in that on p. 41. In the latter the valuation is placed at $6.278, or 75 cents per ton.

18. BLAKE, WILLIAM P.

Quicksilver in Texas.
Mineral Resources of the United States. 1894.
16th Ann. Rept. U. S. Geol. Survey, Part III, pp. 601-604.
Washington, 1895.

See title following.

19. ——————

Cinnabar in Texas.
Trans. American Inst. Min. Engineers, Vol. XXV, pp. 68-76, 1896.

The literature of the quick silver deposits of the United States is thought to contain no reference to this locality. The reported occurrence of cinnabar in Texas is made in the Second Annual Report of the Texas Geological Survey. It is not noticed by Becker in his monograph on Quick Silver Deposits.

"Early in the year 1894, Mr. George W. Manless, of Jimenez, Mexico, agent at that point of the Rio Grande Smelting Works, having learned that some Mexicans had obtained very rich cinnabar in the mountains of Texas, a few miles north of the Rio Grande, undertook, together with

Blake, William P.

Mr. Charles Allen, of Socorro, N. M., an exploration of the region, with the result of finding the cinnabar-deposits and locating them for development. My attention was directed to them through Mr. James P. Chase, of Socorro, with whom I visited the locality in the month of August, last. About the same time a notice of the discovery was printed in Los Angeles, Cal.,* (*The Bulletin, Aug. 14, 1894), and it was also mentioned in one or more of the papers in El Paso, and later in the *Manufacturer's Record*, published in Baltimore.

"The locality is in the southern portion of the part of Texas within the Big Bend of the Rio Grande river, about 80 or 90 miles south of Alpine station, and 90 or 100 miles from Marfa station, on the Southern Pacific Railway. It is 50 or 60 miles from Presidio del Norte, and about 10 or 12 miles from the Rio Grande. These distances, it will be noted, are approximately stated, as there has not been any survey of the region. The longitude is about 27 W., and lat. 29.30 N. The cinnabar is best reached from Marfa by team through an open country, with a gradual descent from the Marfa table-land to the Rio Grande valley, following first the valley of Alamitos and then over a low divide to the Tres Lenguas, which is followed southwards, generally between the flat-topped hills of the mesas on each side, until nearing the Rio Grande, where the road winds among the higher and more rugged hills. The last six miles of the route is impassable for wagons, and the cinnabar camp is reached by a pack-trail, which turns westwards from the wagon-road and leads across a country much broken and intersected by dry 'washes' or creek beds.

"The hills are low, but are much broken by escarpments of nearly horizontal strata of cretaceous limestone. The elevation of the camp is shown by the aneroid barometer to be 3250 feet above tide."

Topography. Major Emory's description of the region. Nature of the country between Marfa and the Tres Lenguas. Table-lands capped with basaltic lava. Church Mountains. San Diego Peak. Beds under the lava thought to be Pliocene and Miocene Tertiary. Descending the valley of the Tres Lenguas cretaceous rocks appear. Discussion of the genesis of cinnabar. Occurrence of cinnabar different from that at New Almaden.

"In considering the source and origin of the cinnabar, we should not lose sight of the fact that there is an intrusion of doleritic rock near by, and that this probably has a direct and close connection, not only with the disturbance of the strata, but also with the source of the metalliferous impregnations."

The conditions for working the ore not as favorable as could be wished. No water near. Wood from the Rio Grande would cost $5.00 and $6.00 per cord. The low grade ore would probably remain useless.

20. Broadhead, G. C.

Mitchell County, Texas.

Correspondence of the American Geologist. Vol. II, pp. 433-436. Minneapolis, 1888.

Texas and Pacific Railroad passes east and west through centre of the county. Crosses Colorado river at Colorado City. Course of Colorado river. "Red Beds" exposed. Paucity of fossils. Section at Colorado

BROADHEAD, G. C.

City. Fossil wood on Wolf Mountain. Beds of brown sandstone. Conglomerate. Lone Wolf Mountain. Strata composing it. Section on Silver creek, Nolan county. Relations with Cretaceous shown. Summary of a boring 1116 feet deep on the hill west of Colorado City. Brine. Buffalo paths in solid rock. Pot-holes at the forks of Champion creek. Altitude of points westward of Fort Worth. Salt deposits. Depth at Kingman, Kansas; at Lyons, Kansas. Salt water near Blue Rapids, Kansas. Depth of salt stratum at Ellsworth, Kansas. The geological position of most of the Kansas and Texas salt beds Permian.

21. CALL, R. ELLSWORTH.

The Tertiary Silicified Woods of Eastern Arkansas.

Amer. Jour. of Science, III, Vol. XLII, pp. 394-401. New Haven, Nov., 1891.

(Silicified Wood in the Texas Tertiary.)

Quotation from R. A. F. Penrose, Jr., in foot note on p. 399, referring to Silicified Wood in the Sabine River Beds of Texas (See First Ann. Rept. of the Geological Surv. of Texas, p. 24).

22. CLARK, WILLIAM BULLOCK.

A Revision of the Cretaceous Echinoidea of North America.

Johns Hopkins University Circulars, Vol. X, No. 87, pp. 75-77, Balto., Apr., 1891.

Among the species considered in this paper are the following from Texas: *Cidaris Texanus* n. sp., Washita Formation of Comanche Series; *Leiocidaris hemigranosus* (Shumard), Washita Formation; *Salenia Texana* Credner, Washita Formation; *Pseudodiaema Texanum* (Roemer), Fredericksburg Formation of Comanche Series; *Pseudodiadema Roemeri* n. sp., Fredericksburg Formation; *Pseudodiadema Hilli* n. sp., Austin Limestone; *Goniopygus Zitteli* n. sp., Fredericksburg Formation; *Holeetypus planatus* Roemer, Fredericksburg Formation; *Pyrina Parryi* Hall, Washita Formation; *Echinobrissus Texanus* n. sp.; *Holaster simplex* Shumard, Washita Formation; *Enallaster Texanus* (Roemer), Fredericksburg Formation; *Epiaster elegans* (Shumard), Washita Formation; *Epiaster Whitei* n. sp., Fredericksburg Formation; *Hemiaster Texanus* Roemer, Upper Division; *Hemiaster Dalli* n. sp., Washita Formation.

23. ————

The Mesozoic Echinodermata of the United States.

Bulletin of the U. S. Geological Surv., No. 97, 207 pp., L plates. Washington, 1893.

In this Bulletin the following species from Texas are described:

Ophioglypha Texana Clark, Denison Beds of Washita Division of Comanche Series, p. 30; *Cidaris Texanus* Clk., Washita Formation, p. 36; *Leiocidaris hemigranosus* (Shumard), "Washita Limestone," p. 38; *Salenia Texana* Credner, Washita Formation, p. 40; *Pseudodiadema Texanum* (Roemer), Fredericksburg Formation of Comanche Series, p. 47; *Diplopodia Texanum* (Roemer), Fredericksburg Formation, p. 48; *Diplopodia*

CLARK, WILLIAM BULLOCK.

Hilli Clk., Austin Chalk, p. 50; *Goniopygus Zitteli* Clk., Caprina Limestone, p. 53; *Pedinopsis Pondi* Clk., Austin Chalk? p. 57; *Holectypus planatus* Roemer, Washita Formation, p. 58; *Pyrina Parryi* Hall, Washita Formation, p. 59; *Echinobrissus Texanus* Clk., Austin Chalk, p. 62; *Holaster simplex* Shumard, Washita Formation, p. 76; *Enallaster Texanus* (Roemer), Fredericksburg Formation, p. 78; *Enallaster obloquatus* Clk., Fredericksburg, p. 79; *Epiaster elegans* (Shumard), Washita Formation, p. 80; *Epiaster Whitei* Clk., Washita Formation, p. 82; *Hemiaster Texanus* Roemer, Austin Chalk, p. 86; *Hemiaster Dalli* Clk., Washita Formation, p. 89; *Hemiaster Calvini* Clk., Shoal Creek Limestone, p. 90; ? *Holectypus simplex* Shumard. Meek includes this species in his list of Cretaceous Echinodermata, giving Texas as the locality. His reference to this species is probably an error. P. 93.

24. COMSTOCK, THEO. B.

The Geological Survey of Texas.

Engineering and Mining Journal, Vol. XLIX, pp. 384-386, New York, Apr. 5, 1890.

"There have been three distinct periods of popular interest in the discovery and development of the mineral resources of Texas." The Shumard (B. F.) Survey in 1858. The Survey of 1870. The present (3d) Survey under the direction of E. T. Dumble. Personnel of the Survey. Areas assigned the different geologists. Announcement of facts concerning the economic resources thus far discovered. 1. Precious Metals. 2. Copper. 3. Lead. 4. Iron. Analyses of Magnetites, Hematites and Limonites. 5. Manganese. 6. Zinc, Tin, etc. 7. Rare Metals—Gadolinite.

25. ——————

Report of. First Ann. Rept. Geol. Surv. of Texas, 1889, pp. lxxxviii-xc. Austin, 1890.

Administrative Report of the Geologist for Central Texas. Plans of field work for 1889; personnel of parties; topographic work of Mr. J. C. Nagle; acknowledgments.

26. ——————

A Preliminary Report on the Geology of the Central Mineral Region of Texas.

First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 237-391; 3 ills.; 1 pl. Austin, 1890.

Contents: Introduction. Pt. I. Stratigraphic Geology. Archæan group. Burnetan system. Fernandan system. Eparchæan group. Classification of Pre-Paleozoic Igneous rocks. Paleozoic group. The Cambrian system. The Silurian system. The Niagara (Upper Silurian) system. The Devonian system. Post-Paleozoic uplifts. The Pre-Cretaceous movement. The Post-Cretaceous deposits. Relations of the Wichita Mountains to the Central Paleozoic area. Part II. Economic Geology. Precious Metals. Base Metals. Manganese Ores. The Iron

COMSTOCK, THEO. B.

Ores. Rare Minerals and Precious Stones. Building Materials. Refractory Materials. Materials for Paints. Miscellaneous Economic Products. Part III. List of Minerals collected by the Survey from the Central Mineral District.

"The area included in the present review comprises a portion of what has been, not inaptly, termed the 'Paleozoic Region of Central Texas.' The general plan of the work of this division of the Geological Survey has been to confine attention, in most cases, to the rocks of the Pre-Carboniferous age, giving heed to the more recent strata only in so far as it semed necessary in order to present a clear and complete geologic history of the district.

"As will be apparent from a cursory examination of the accompanying geologic map, the natural boundaries of this district are the escarpments of the Carboniferous and Cretaceous systems, the latter being by far the more extensive, and in some places completely obscuring the earlier rocks. No serious attempt has been made to classify any of the divisions above the base of the Carboniferous system, although incidental notes are recorded which may perhaps prove useful to students of the later sediments. As thus limited, the 'Central Mineral Region'* (*"The title of 'Central Mineral Region' is adopted by Mr. E. T. Dumble, State Geologist, to designate this district as defined above; or, more properly, a restricted area within this field."—Foot note, p. 239) comprises all of the counties of Llano and Mason, and large portions of the neighboring counties of Burnet, San Saba, McCulloch, Menard, Kimble, Gillespie and Blanco, with extensions into Lampasas and Concho counties. The area in square miles is about 3,800, equivalent to more than three-fourths of the State of Connecticut, and nearly one-half of the area of New Jersey, and 500 square miles more than the combined superficies of Delaware and Rhode Island, and yet forming less than .014 of the total area of the State of Texas." P. 239.

27. ——————

The Industrial Growth of Texas.

The Age of Steel, Vol. LXIX, No. 1, pp. 19-22. St. Louis, Jan. 3, 1891.

A popular article on Texas, in which, among other matter, reference is made to the mineral resources of the State.

28. ——————

Tin in Texas.

Eng. and Mining Jour., Vol. LI, pp. 117-118. New York, Jan. 24, 1891.

An announcement of the facts concerning the discovery of tin in Texas. The existence of tin ore in the State had been claimed for a number of years. There is no instance on record of what proved to be the discovery of more than traces until the author's announcement, in 1889, of the receipt of a small crystal of cassiterite from a resident of Llano county. In November the author's attention, in working up and determining minerals, was called to some former collections made by the Geological Survey, and turned over to him for study, from Barrenger Hill, and from a local-

COMSTOCK, THEO. B.

ity in Mason county not yet critically examined. A large inclusion was found in quartz, and the occurrence of tungsten and niobium was also noteworthy. A special trip was made to the neglected region. The report of Mr. George Durst as to the existence of old furnaces was verified. Slag at one place was said to contain globules of silver. Careful examination showed the inclusione to be tin, not silver, and that the whole slag carries abundant traces of tin. A detailed description of this district is found in the Second Ann. Rept. of the Geol. Surv. of Texas, pp. 595-602.

The tin territory is defined as a tract fifty miles long, ten to fifteen wide, extending from western Burnet to eastern Mason across the center of Llano county.

The above announcement called forth a statement by "G. A. F." that tin had previously been found, in 1866, twenty miles south of Gonzales, and, in 1867, at two localities on the Nueces river. He also states that tin had been found in Llano county in 1877. Eng. and Min. Jour., LI, p. 229. Feb. 21, 1891.

29. ——————

Tin in Central Texas.

Correspondence.

Engineering and Mining Journal, Vol. LI, p. 281. N. Y., March 7, 1891.

A reply to "G. A. F."

"Two instances reported by him are from South Texas, beyond the limits of my investigations, and both of them appear to have been heretofore unrecorded. The localities are both in the Tertiary Area, from which the discovery only of drift or secondary deposits of little commercial value can ever be anticipated."

30. ——————

Occurrence of Tin in Central Texas.

American Journal of Science, III, Vol. XLI, p. 251. New Haven, March, 1891.

In a note bearing the above title, dated January 24, 1891, Professor Comstock makes a statement concerning the discovery of Cassiterite in Central Texas.

31. ——————

Report of.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. xciv-xcviii. Austin, 1891.

Administrative report of the Geologist for Central Texas for 1890. Exploration of a district (Wichita Mountains) in Indian Territory with Mr. Cummins. Personnel of the field party for the Central Mineral Region. Character of the region traversed. Method of survey adopted. Office assistants. Topographic work of Mr. J. C. Nagle. Work of Mr. Charles Huppertz, geologic aid. Work of Messrs. Jones and Clark. The Con-

COMSTOCK, THEO. B.

struction of maps. Geological conclusions tentatively announced in the First Annual Report, mostly confirmed by subsequent field work. Material on hand. Fossils from the Cambrian, Silurian and possible Devonian. Minerals. Discovery of tin ore. Acknowledgments.

32. ——————

Report on the Geology and Mineral Resources of the Central Mineral Region of Texas, chiefly south of the San Saba river and north of the Pedernales river, west of Burnet and east of Menardville and Junction City.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 553-664; 2 plates; 2 maps; 9 figures. Austin, 1891.

"Skeleton: Part I.—General Review of Geologic Structure. Outline of the geologic groups, for the use of persons engaged in prospecting and development. Statement of the classification adopted, with chart showing the various terranes in chronologic order. General statement of the economic products of each main geologic horizon. Part II.—Economic Geology. How to use the report for practical purposes. Plan of this part. Metalliferous Deposits. Precious Metals. *Gold.*—Possible sources stated, with results of assays, etc. *Silver.*—Sources of supply. Districts limited and ores discussed. Base Metals. *Copper.*—Belts defined, with descriptions of localities and cuts showing structure. *Lead.*—Districts outlined; outcrops illustrated and described. Review of the situation. Guide to prospectors. Table I. Assays for gold, silver, copper, and lead. *Tin.*—Full discussion of the present situation, with cuts showing the geologic conditions where tin ore has been found; character of ore and mode of occurrence. Uncertainty of discovering the mineral in commercially important quantities. *Zinc.*—Absence from this district. Unsupported claims of discovery of zinc blende in 1890. *Manganese.*—Areas in which the ores outcrop. Belts defined. Discussion of ores and modes of occurrence. Table II. Analyses. *Iron.*—Extent and importance of the ores of the district. Hints regarding the development of the iron fields. Separation of the ores into five classes, individually discussed in detail, with location, description, and full treatment of the six great belts, or axes, including important hints concerning the mining of ores. Table III. Analyses of iron ores. Metallurgic review of iron fields. Probable future of the iron industry.

Building Stones. *Granites.*—Seven classes, distribution and economic value. *Marbles.*—Three classes, their distribution and uses. *Limestones and Dolomites.*—Localities and character of material. *Sandstones, Slates, Schists, Clays,* and materials for *Cements, Lime, Mortars,* etc.

Refractory Materials. Fictile Material. Materials for Paints.

Part III.—Supplement. Additional notes on stratigraphic geology." P. 555.

"The area of Pre-Carboniferous rocks comprising the Central Mineral Region, as defined in the Report of this Survey for 1889, was estimated at less than four thousand square miles. The more complete survey of 1890 has materially extended the boundaries of the tract by the discovery of uncovered Silurian and Cambrian strata in extensive fields hitherto sup-

COMSTOCK, THEO. B.

posed to be capped by the Cretaceous. The maps accompanying the present Report include only enough of the territory outlying to give a fair idea of the relations of the Pre-Carboniferous terranes to those of more recent origin. These sheets represent an area of six thousand square miles, of which considerably more than five thousand square miles contain exposures of an earlier date than the Carboniferous." P. 556.

"There are representatives of the Archean, Eparchean, and Paleozoic groups in the Central Mineral Region, which, as we now understand them, are regarded as the geologic equivalents of the Laurentian, Ontarian, Algonkian, Cambrian, Silurian, and Devonian systems of other parts of the United States." P. 556.

Numerous analyses of Iron Ores, Magnetites, Hematites, Sandy Ores, Segregated Ores, Soft (hydrated) Ores and Titaniferous Ore, are given on pp. 634-635.

33. ————————

Report of.

(A Preliminary Report on Parts of the Counties of Menard, Concho, Tom Green, Sutton, Schleicher, Crockett, Val Verde, Kinney, Maverick, Uvalde, Edwards, Bandera, Kerr, and Gillespie.)

Geological Survey of Texas Second Report of Progress, 1891, pp. 43-54. Austin, 1892.

Contents: Introduction. The General Geologic Section. Topographic Features. Agricultural Possibilities. Water Supply—Artesian Water. Mineral Resources—Ores of Metals other than Iron; Iron Ores; Koalin; Asphaltum; Coal or Lignite; Building Materials. Conclusion.

"The rocks which lie at surface in the counties immediately bordering the Central Mineral Region are of Lower Cretaceous or Jurassic time. The settlement of the real horizons of the beds must be relegated to the specialists who are still debating the question. It is sufficient for our immediate purpose to warn investors that, in any event, no valuable deposit of coal or lignite may be expected within this range, although worthy people have proposed boring to test the matter. All the important lignite layers lie in a geologic position considerably above this." P. 44.

"The topography of the Cretaceous area is distinctive and pronounced, a characteristic example of simple drainage erosion carried to a numerical extreme without widespread denudation. To express it otherwise, the results are those accomplished by myriads of streams of small extent, which have cut deep and narrow canyons, leaving innumerable peaks, buttes, and 'hog-backs' in the intervening spaces. Thus the plateau levels corresponding to successively exposed hard layers are extensive, but so badly cut up by ramifying streams that it is impossible to travel across them except by frequent ascent and descent of steep inclines. This peculiarity gives to one following the valley roads of the country only an idea about as erroneous as is obtained by one who pursues the cross-country course, although either one will be liable to regard the region as more complicated in structure than it really is." Pp. 45-46.

COMSTOCK, THEO. B.

"The pastural and agricultural capabilities of the major part of the region are by far greater than has been generally appreciated. Much of the area which is now neglected or given over to grazing can be eventually utilized for tillage. In the river valleys irrigation is perfectly feasible, and in many places where the streams are dry at surface there is an abundant supply of water not far below throughout the year; windmills and 'water-holes' (tanks) now supply the needs as they exist, but a very much larger population and a materially increased productiveness will follow the advent of the steam pump, as it has already in other similar cases where capital has been freely expended." Pp. 46-47.

"The lignite field, so far as it lies within the limits of our survey of 1891, is confined to a comparatively narrow tract extending across the Rio Grande from Mexico into Maverick county, Texas, north of Eagle Pass. The lignite is of excellent quality, as a rule, and in many localities along the northern and western edge of the field it is well exposed for economical mining. It has been worked successfully in a few places near the surface, and it has been discovered by boring or shafting at other points at depths varying from twenty feet and less to three hundred feet and more. The Hartz Mine has the most extensive development." Pp. 52-53.

34. ————————

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. liv-lv. Austin, 1892.

Administrative report of the Geologist for Central Texas covering the field season from May 25th to September 1st, 1891. Region examined. Personnel of the party. Work of Mr. R. A. Thompson, topographer. Work of Mr. F. S. Ellsworth, aid. Acknowledgments.

35. ————————

(Tin in Texas.)

See Rolker, Charles M., The Production of Tin in Various Parts of the World, 16th Annual Rept. of the U. S. Geol. Survey, Pt. III, pp. 528-529. Washington, 1895.

36. (COPE, EDWARD D.)

Review of a paper on "The Cross Timbers of Texas," read by Robert T. Hill before the Washington Philosophical Society.

American Naturalist, Vol. XXI, p. 172. Feb., 1887.

"The article demonstrated that these two belts of anomalous timber, instead of representing quaternary or tertiary basins, are merely the detritus of outcrops of arenaceous strata, those of the eastern member being probably of the age of the Dakota sandstone, and the western of a sandy group at the base of the entire cretaceous series, part of which are of undetermined Mesozoic, and are given the name of 'Dinosaur sands' by Mr. Hill, while a part of them are of undoubted Carboniferous age. He furthermore shows that the topography of the entire central region is the result of extensive denudation, whereby the members of the geologic

COPE, EDWARD D.

series, from the marine tertiary to the Carboniferous coal-measures, are successively exposed along the line of the Texas Pacific Railroad from Elmo to Millsap. The most interesting feature of Mr. Hill's paper, however, is that he demonstrates the existence of a marine group of the Cretaceous in Texas lower than any heretofore recognized in America, and completely clears up, by methods of stratigraphic palaeontology, the vagueness that has hitherto accompanied our knowledge of that region."

37. ————

The Mesozoic and Caenozoic Realms of the Interior of North America.

(The Comanche.)

Amer. Naturalist, Vol. XXI, pp. 447-448. May, 1887.

A brief description of the "Comanche Series" of Texas.

38. ————

Mr. Hill on the Cretaceous of Texas.

Amer. Naturalist, Vol. XXI, pp. 469-470. May, 1887.

A further review of Professor Hill's paper on "The Topography and Geology of the Cross Timbers and Surrounding Regions in North Texas," (Am. Jour. Sci., III, XXXIII, 291-303), in which the writer protests against the duplication of names in the classification of the Cretaceous therein proposed.

39. (————)

The Vertebrate Fauna of the Equus Beds.

American Naturalist, Vol. XXIII, pp. 160-165. Feb., 1889.

"While the Equus Beds are found at various localities in North America, the greater number of characteristic species of vertebrata have been obtained in three regions. First, the Oregon Desert; second, the country of the Nueces, S. W. Texas; third, the Valley of Mexico. I give lists of the species found at these and their localities."

The list from S. W. Texas is as follows: "*Equus barcenaei*, Cope, *E. fraternus*, Leidy, *E. excelsus*, Leidy, *E. occidentalis*, Leidy, *E. crenidens*, Cope, *Elephas primigenius*, Blum., *Canis* sp., *Glyptodon petaliferous*, Cope, *Cistudo marnochii*, Cope," p. 161. An enumeration of the species common to the Valley of Mexico and the Oregon Desert is given. "Of these, the *Equus excelsus*, and *Elephas primigenius* have been found in S. W. Texas. These species, with the *Equus barcenaei*, *E. crenidens*, and probably the *Glyptodon petaliferous* are common to the last named locality and the Valley of Mexico." P. 164.

Of this paper only those parts relating to Texas receive mention.

40. ————

The Proboscidia.

American Naturalist, Vol. XXIII, pp. 191-211, with plates and figures. Apr., 1889.

Mention is here made of only those parts of the paper referring to spe-

COPE, EDWARD D.

cies found in Texas. *Mastodon serridens*, Cope, p. 196. *Tetrabelodon* ? *serridens*, Cope, p. 205. Fig. 8 gives two views of ? first molar. "Typical specimen from ? Pliocene of Texas."

"Falconer regarded the true elephant of Texas as a distinct species, which he named *E. columbi*. He distinguished it by the coarse plates of the enamel, and by the wide lower jaw, with curved rami, and short symphysis. * * * I have in my museum an entire skull, lacking the lower jaw (Plate XIV), from the 'orange sand' of the city of Dallas, in Northeastern Texas, which only differs in form from that of the *E. primigenius* as figured by Blumenbach and Cuvier in the shorter and wider premaxillary region." Pp. 207-208. Other comparisons follow. A figure of the Dallas specimen is given on p. 208.

41. ——————

On the Skull of the Equus excelsus Leidy, from the Equus Bed of Texas.

Amer. Naturalist, Vol. XXV, pp. 912-913. Oct., 1891.

"I have received from my valued correspondent, William Taylor, a skull of the *Equus excelsus*, which is of much interest as the first that has come to light in the United States. It lacks only the posterior and inferior walls of the brain case, and the premaxillary region was detached in such a way that its length is not absolutely certain, though contact of the adherent matrix was found. This skull shows that the *Equus excelsus* is intermediate in characters between the horse and the quagga and allied species, and possesses some Hippidium characters in addition. The resemblance is, however, greater to the quagga."

Comparison with the quagga. The skull is that of an adult female. Frontal bone crushed as if with a hammer. Stone hammer found in the same bed.

42. ——————

A contribution to a Knowledge of the Fauna of the Blanco Beds of Texas.

Proceedings of the Acad. of Nat. Sciences, Phila., Pt. II, pp. 226-229. Apr.-Oct., 1892.

"Prof. E. T. Dumble, State Geologist of Texas, appointed Prof. W. F. Cummins to conduct the survey of the northwestern district of the State, and in pursuance of this order the latter gentleman is now examining the mesozoic and cenozoic beds which compose and underlie the Staked Plains. I accompanied this party in the capacity of paleontologist, having already determined the vertebrate fossils collected by the Survey's expeditions of last year (see Proceedings of the American Philosophical Society, first No., for 1892).

"The superficial formation of the Staked Plains has been determined by Prof. R. T. Hill to be of late cenozoic age, and the term Blanco Beds has been applied to it by Prof. Cummins. The examination of the vertebrate fossils from it led me to state (*loc. cit.*) that in age the Blanco formation intervenes between the Loup Fork below and the Equus beds above, in the series. This conclusion was based chiefly on the fact of the presence of

COPE, EDWARD D.

horses of the genus *Equus* (*E. simplicidens* Cope) in association with mastodons of the molar dental type of the *Tetrabelodon angustidens*, an association not previously met with in North America. In addition to these species, the presence of a peculiar land tortoise (*Testudo turgida* Cope), and of a new genus of birds allied to the rails (*Crecoides* Shuf.) was established.

"I propose to present to the Academy a list of the species obtained, so far, from the Blanco beds by the present expedition, with such conclusions as may be derived from it."

Testudinata: *Testudo turgida* Cope loc cit. *T. pertenuis* sp. nov. Description. Edentata: *Megalonyx* sp. Carnivora. Proboscidia: *Mastodon successor* sp. nov. *M.* cfr. *mirificus* Leidy, *M.* cfr. *shepardii* Leidy. Perissodactyla: *Equus simplicidens* Cope, l. c. *E.* sp., *E.* a second sp. Artiodactyla: *Pliauchenia.*

43. ———

In the Texas Panhandle.

Correspondence.

Amer. Geologist, Vol. X, pp. 131-132. Minneapolis, August, 1892.

A letter dated Clarendon, Texas, June 13, 1892. A ride of 250 miles from Big Springs, a station of the Texas and Pacific railroad. Dry season. Weather. Difference in temperature between day and night often 30-40 degrees. Difference in the feeling of heat here and in Philadelphia. Bad water. Party in charge of W. F. Cummins. Line of travel along the eastern escarpment of the Staked Plains. Accessible Permian, Trias, Loup Fork and Blanco beds. The latter contain a new vertebrate fauna, mostly mammals. Of fourteen species collected, ten are new, two of them mastodons. Loup Fork beds and numerous fossils—horses, camels and mastodons. Acres covered with bones. The Blanco beds form the entire surface of the Llano Estacado. Underlain by Trias and Permian. How far the Loup Fork passes under the plains is unknown.

44. ———

(Geology of the "Staked Plains.")

Amer. Geologist, Vol. X, p. 196. Minneapolis, September, 1892.

A note, under the heading Personal and Scientific News, beginning as follows: "According to Prof. E. D. Cope, the 'Staked Plains' of Texas are composed of Cenozoic strata, divisible into *Equus beds, Blanco Cañon* and *Loup Fork*, the last being lowest, confirming the determinations of Prof. Hill." Underlain by Trias. Equus beds have a well-known vertebrate fauna. Same true of Loup Fork beds. Paleontological blank between filled by the discovery of the Blanco Cañon beds. No marine forms in these beds or in the Triassic or Permian below. He considers the Equus beds as probably of the age of the La Fayette. He obtained the remains of *Megalonyx* in the Blanco Cañon beds and several species of the horse in the Equus beds.

45. COPE, EDWARD D.

A Hyena and Other Carnivora from Texas.

Proc. Acad. of Nat. Sciences, Phila., Pt. III, pp. 326-327. Oct.-Dec., 1892.

"Prof. E. D. Cope stated that he had, during the past season, while exploring the eastern front of the Staked Plains of Texas with a party of the Geological Survey of that State, under Prof. W. F. Cummins, obtained the remains of some interesting Carnivora from the Blanco or Pliocene beds. One of these is a hyena nearly allied to the genus *Hyaena*, and the first species of this family found in America. It, however, differs from the typical genus in having a fourth premolar in the lower jaw, and probably in having a shorter blade of the sectorial tooth in the upper. He proposed the name *Borophagus* for the genus, and for the species the name *diversidens*." * * *

* * * * * * *

"Another interesting carnivore is a weasel of a new genus and species, which it was proposed to call *Canimartes cumminsii*, after its discoverer." * * *

"A third carnivore is a cat, provisionally referred to the genus *Felis* under the name of *F. hillianus*, after Prof. Robert T. Hill, the well-known geologist. This cat is about the size of the cheetah, and has large canine teeth without grooves, and the feet are shorter than in modern cats."

46. ——————

On the Characters of Some Paleozoic Fishes.

Proceedings of the U. S. Nat. Museum, Vol. XIV, 1891.

II.—On New Ichthyodorulites.

Pp. 448-449. Washington, 1892.

Hybodus regularis, sp. nov.

Description.

"The fine specimen on which this species is based was obtained by Jasob Boll from a soft Mesozoic limestone in Baylor county, Texas, which is probably of Triassic age. The species approaches most nearly the *Hybodus major* of Agassiz, from the Muschelkalk. In that species the teeth are stated to be mere tubercles, which is not the case in this species." P. 448.

Ctenacanthus amblyxiphias, sp. nov.

Description.

"The Permian formation of Texas; W. F. Cummins." P. 449.

47. ——————

Report on the Paleontology of the Vertebrata.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 249-259. Austin, 1892.

Also Proceedings of Amer. Phil. Soc., Vol. XXX, No. 137, pp. 123-131.*

Contents: I. Fayette formation. II. Upper Cenozoic of the Staked

COPE, EDWARD D.

Plains. *Equus simplicidens,* Cope. *Creccoides osbornii,* Shufeldt. *Testudo turgida.* III. On a Mesozoic Pycnodont—*Microdus dumbleii.* IV. Triassic or Dockum beds. *Episcoposaurus haplocerus.*

"I. Fayette Formation.

"In the First Annual Report of the Geological Survey of Texas (p. 47), Mr. R. A. F. Penrose, Jr., describes this formation as it occurs in South and East Texas. He places it at the summit of the Tertiary series and below the 'Post-tertiary'; that is, at the summit of the Neocene, just prior to the advent of the Pleistocene. This location is justified by the only vertebrate fossils definitely traceable to these beds, which have been sent me for identification by Mr. E. T. Dumble, State Geologist of Texas. One of these consists of a well-preserved left ramus with symphysis and nearly complete dentition of the mandible of the large lama, *Holomensicus hesternus* Leidy. This species is characteristic of the Equus beds of Oregon, California and Mexico, and indicates satisfactorily the age of the formation in which it occurs. It confirms fully the position assigned to the Fayette beds by Mr. Penrose and by President Chamberlain for their eastern extension. The only other identifiable fossil from this formation is several teeth of the *Equus major* Dekay. This species is most abundant in the Eastern States, where the Equus beds have not been certainly identified; but it occurs also in the Equus beds of Nueces county, with other characteristic species of that epoch. The specimens of the two species named came from Wharton county."

"II. Upper Cenozoic of the Staked Plains.

"In some remains of vertebrata, obtained by Mr. W. F. Cummins, from Crosby county, Texas, and sent me for determination by Mr. E. T. Dumble, State Geologist, four genera may be identified, and several others are indicated. The four genera are Equus, Mastodon, Creccoides g. n., and Testudo. They are enclosed in a white siliceous friable chalk, which Mr. Louis Woolman finds on examination to be highly diatomaceous. Professor C. Henry Kain had identified the following species: *Campylodiscus bicostatus* W. Smith; *Epithemia gibba* Ehr.; *E. zebra* Ehr.; *E. gibberula* var. *producta* Ehr.; *Navicula major* Ehr.; *N. viridis* Ehr.; *N. rostrata* Ehr.; *N. elliptica* var. *minutissima* Green; *Gomphonema clavatum* Ehr.; *Cymbella cistula* Hemp.; *Fragillaria vivescens* Raffs var. The formation has been named the Blanco Canyon by Mr. W. F. Cummins, of the Survey (Report 1890, p. 190, without specific location in the Cenozoic series).

"The Mastodon is of the *M. angustidens* type, as indicated by the teeth, but there are not enough fragments preserved to render it clear whether they pertain to this species or some allied one. The Equus is allied to the *E. occidentalis* of Leidy, but the enamel plates are more simple than in that species, being the most simple known in the genus. I regard it as an undescribed species, and describe it below under the name of *Equus simplicidens.* A second species of horse is indicated, but an exact determination cannot be made without additional material. The tortoise is a terrestrial form, but there is not enough preserved for identification." Pp. 251-252.

48. COPE, EDWARD D.

The Cenozoic Beds of the Staked Plains of Texas. (Abstract.)

Proc. Amer. Assoc. for the Adv. of Science, Vol. XLI, p. 177. 1892.

"The Cenozoic beds referred to are the Loup Fork, Blanco and Equus beds. Their geographical and stratigraphical relations and their paleontology are described, especial attention being given to the Blanco Fauna, which is intermediate in character between the others." See "A Preliminary Report on the Vertebrate Paleontology of the Llano Estacado," Geol. Surv. of Texas, Fourth Annual Report, Pt. II, pp. 3-136.

49. ———————

A Preliminary Report on the Paleontology of the Llano Estacado.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. II, pp. 3-136; 1 cut; xxiii plates. Austin, 1893.

Contents: Introduction by E. T. Dumble, State Geologist. Chap. I.—The Vertebrate Remains from the Dockum Terrane of the Triassic System. Batrachia. Reptilia: Belodon, Meyer; *B. superciliosus* Cope; Palæoctonus Cope; *P. orthodon* Cope; *P. dumblianus* Cope. Summary. Chap. II.—The Vertebrate Fauna of the Loup Fork Beds. Proboscidia: Tetrabelodon Cope; *T. serridens* ? Cope. Diplarthra: Aphelops Cope; *A. fossiger* Cope; Protohippus Leidy; *P. pachyops* Cope; *P. perditus* Leidy; *P. parvulus* Marsh; *P. fossulatus* Cope; *P. mirabilis* Leidy; *P. placidus* Leidy. Hippotherium Kaup; *H. affine* Leidy; *H. occidentale* Leidy. Procamelus Leidy; *P. robustus* Leidy; *P. gracilis* Leidy; *P. leptognathus* Cope. Blastomeryx Cope; *B. gemmifer* Cope. Appendix to the Report on the Loup Fork Terrane. *Protohippus lenticularis* Cope; *P. perditus* Leidy. *Hippidium interpolatum* Cope; *H. ? spectans* Cope. *Equus eurystylus* Cope. Synopsis of Species. Chap. III.—The vertebrate Fauna of the Blanco Beds. Testudinata. Testudo: *T. turgida* Cope; *T. pertenuis* Cope. Edentata. Megalonyx, Jeff.; *M. leptostomus* Cope.; Carnivora. Canimartes: *C. cumminsii* Cope. Borophagus: *B. diversidens* Cope. Felis: *F. hillanus* Cope. Proboscidia. Tetrabelodon: *T. shepardii* Leidy. Dibelodon: *D. humboldtii* Cuvier; *D. tropicus* Cope; *D. præcursor* Cope. Diplarthra. Equus: *E. simplicidens* Cope; *E. cumminsii* Cope; *E. minutus* Cope. Platygonus Le Conte: *P. bicalcaratus* Cope; Pliauchenia Cope: *P. spatula* Cope. Summary.

Chap. IV.—The fauna of the Equus Beds. Testudinata. Testudo Linn.; *T. laticaudata* Cope; *T. hexagonata* Cope. Edentata. Mylodon: *M. ? sodolis* Cope. Proboscidia. Elephas Linn. *E. primigenius* Blum. Diplarthra. Equus Linn.; *E. tau* Owen; *E. semiplicatus* Cope; *E. excelsus* Leidy; *E. major* Dekay. Holemeniscus. *H. hesternus* Leidy; *H. sulcatus* Cope; *H. macrocephalus* Cope. Summary of the species of the Equus Beds of the Staked Plains.

"The results brought out by the report of Prof. Cope, which follow, are the determination of the occurrence of both Tertiary and Quatemary deposits [in the region of the Llano Estacado], and that the forms of the

COPE, EDWARD D.

Blanco and Goodnight beds not only present new species, but are strictly intermediate between the Loup Fork and Equus beds, and, as he says, more strictly Pliocene in character than any of the interior lake deposits heretofore described.

"The paper here presented is therefore of importance, not only as definitely determining the ages of certain portions of the Plains deposits, but as a valuable addition to our knowledge of these most interesting forms of life which were the precursors of those of the present." From Introduction by E. T. Dumble, p. 9.

50. ——————

On the Genus Tomiopsis.

Proceedings of Amer. Phil. Soc., Vol. XXXI, pp. 317-318 1893.

Tomiopsis—description of a tooth upon which the new genus is founded.

"The general characters of this tooth are those of mammal of the order Bruta (Edentata). It resembles no known form of the order, but might be said to be intermediate between those of an armadillo and a sloth."

Specific characters.

"This animal left its remains in a bed of probably Neocene age, which is exposed on the Lapara creek in Western Texas. It was associated with the scales of Lepidosteus, and the bones of Trionyx and a tooth of a crocodile, which do not furnish an exact clue to the age of the formation."

The specimen was obtained by State Geologist Dumble.

51. ——————

Description of a Lower Jaw of Tetrabelodon shepardii Leidy.

Proceedings of Acad. of Nat. Sciences, Phila., Pt. II, pp. 202-204. Apr.-Sept., 1893.

"This species has been known hitherto by a third inferior molar only. This has been described or figured at the following places of reference:

Mastodon shepardii Leidy, Proc. Acad., Philadelphia, 1870, p. 98; 1872, p. 472. Cope, American Naturalist, 1884, p. 524.

Dibelodon shepardii Cope, Proc. Amer. Philosoph. Soc., 1884, p. 5, partim.

Mastodon obscurus Leidy, partim, Report U. S. Geol. Survey Terrs., I, p. 330, pl. XXI, 1873.

"A lower jaw of this species, lacking the condyles and supporting the second and third true molars, was taken from the bluff in Crosby county, Texas, from the same excavation that yielded the *Pliauchenia spatula* Cope, and within fifty feet of that at which the tooth of the *Dibelodon praecursor* was obtained. It came into possession of Mr. M. M. Cox, of Estacado, from whom I obtained it by purchase after my return from Texas. The acquisition of this specimen is important as enabling me to determine the true characters of the species. Besides the last inferior molar, Leidy has referred to it provisionally a fragment of a tusk, which, like the molar, came from California."

Description. Measurements of *T. shepherdii.*

52. COPE, EDWARD D.

Observations on the Geology of Adjacent Parts of Oklahoma and Northwest Texas.

Proc. Acad. of Nat. Sciences, Phila., Pt. I, pp. 63-68. Jan.-Apr., 1894.

An account of an expedition in the interest of vertebrate paleontology made during the summer of 1893. List of contributors to the expedition fund. The month of July and thirteen days of August occupied in explorations in the Standing Rock and Cheyenne River Sioux Reservations in North and South Dakota. Fossils obtained and localities visited.

Investigation of the Upper Permian Bad Lands of the Cimarron in Oklahoma. The Cretaceous age of the formation which constitutes the higher levels at the heads of the canyons tributary to the Cimarron. List of Mollusks determined by Prof. Brown. Vertebrate remains.

"I have never found Lepidotid fish remains in the Upper Cretaceous of North America, while they are characteristically Lower Cretaceous and Jurassic in Europe. The only occurrence of Lepidotid fishes so far recognized in North America is based on some teeth sent by Mr. Charles H. Sternberg in the Dakota sandstone of Kansas, and on the new species, *Macrepistius arenatus*, from the Trinity bed of Texas discovered by Prof. R. T. Hill. (See Journal of the Academy, Vol. IX, Part 4.)" P. 65.

Rocks corresponding (according to Brown) with the Comanche Peak terrane of the Texas geologists.

The Permian Red Beds. Remnant of the Loup Fork or the Upper Miocene.

"With the view of further determining the extent of the Comanche and Loup Fork formations, we left Fort Supply and went by rail to Miami, which is a village in Roberts county, of the Panhandle of Texas, south of the Canadian river. For several miles before reaching Miami, the railroad runs between steep bluffs, which form the southern border of the flood plains of the Canadian river, and are the escarpments of the outlying tracts and fingers of the Staked Plains. They are about two hundred feet in elevation, and include two hard strata, while the great mass is sandy clay, or sand in a few localities. One of the indurated beds is at the summit of the bluffs, forming the surface of the plain, and is about six feet in thickness. The softer argillaceous bed below it varies from fifteen to fifty feet, when the second impure sandstone is reached, which has a thickness of about eight feet. The one hundred and fifty feet below this is friable, so that the construction of the escarpment is such as to keep it more or less perpendicular. The general appearance of the bluffs is closely similar to that of the Blanco beds at the typical locality one hundred and fifty miles south, at the point where the Brazos river issues from the Staked Plains in the Blanco Canyon. In order to ascertain whether this formation is the Blanco or the Loup Fork, which it resembles, we examined the bluffs for a day and a half for fossils. They are rare in that region, but I obtained, on the second day, teeth of both series of a horse, *Equus cumminsii* Cope, which demonstrated at once that the age is the Blanco. Mr. Brown found camel bones which approach in

COPE, EDWARD D.

dimensions those of the Blanco species, rather than those of the Loup Fork; but the species could not be identified.

"On the succeeding day, we drove, thanks to Mr. R. T. Cole, of Mobeetie, to the town of Mobeetie, in Wheeler county, eighteen miles S. E. of Miami. The route takes the traveler across a part of the Staked Plains, and a considerable distance before Mobeetie is reached, ravines belonging to the drainage system of the tributaries of the Red River are passed. We examined a number of these for a considerable distance without obtaining fossils. As we passed the deserted Fort Elliott, near to Mobeetie, I examined some sandy beds like those of the Upper Blanco beds, and obtained additional tooth fragments of *Equus cumminsii* and a second species of *Equus*, probably *E. eurystylus*, and fragments of teeth and other bones of undeterminable camels. We thus determined the extension of the Blanco bed as far east as Mobeetie.

"The result of my observations on this, the northeastern border of the Staked Plains, is to the effect that this plateau to the north of the Red River, like that part to the south of it, belongs to the Blanco deposit, giving the latter a north and south extent of two hundred and fifty miles. It had been hitherto positively determined at the typical locality only, that distance south of Miami, on the upper waters of the Brazos. From this point to the Red River the formation appears to be continuous, and the portion north of the Red River now described not only has a close physical resemblance to the portion south of it, but contains, as now appears, fossils of the same age. (See Report of the Geological Survey of Texas for 1892, for reports by Cummins and Cope on the Blanco Terrane.)"

Examination of the Upper Permian at Tucker, O. T., and Pleistocene sands at Wellington, Kansas. Vertebrate remains near Hennessy, O. T.

53. ————

The Reptillian Order of Cotylosauria.

Proceedings of the Am. Phil. Soc., Vol. XXXIV, pp. 436-457; pls. vii-ix. Phila., 1895.

Characters of the Order. The Families of the Order, viz.: *Elginiidae*, *Parisauridae*, *Diadectidae*, *Pariotichidae*. None of the species embraced in the first two families are found in Texas. The following species, constituting the *Diadectidae*, are from the Permian of Texas: *Diadectes sideropelicus*, *Empedias molaris*, *E. fissus*, *E. phaseolinus*, *E. latibuccatus* and *Chilonyx rapidens*. The *Pariotichidae*: *Isodectes megalops*, Cope, from the Permian of Texas. Description of *Captorhinus angusticeps*, sp. nov. From Permian of Texas. Description of the genus *Pariotichus*, Cope, *P. brachyops*, Cope, *P. incisivus*, Cope, *P. ordinatus*, Cope, all from the Texas Permian. Description of *P. isolomus*, Cope, sp. nov. Texas Permian. *P. aguti*, Cope, *P. hamatus*, Cope, *Pantylus cordatus*, Cope, Texas Permian, *P. coïcodus*, Cope, sp. nov. Hypopnous, Cope, gen. nov. *Hypopnous squaliceps*, sp. nov. Permian of Texas.

Supplement.

Some New Batrachia from the Permian Bed of Texas. Descriptions of new species: *Zatrachys microphthalmus*, *Z. conchigerus*, *Trimerorhachis mesops*, *Diplocaulus magnicornis*, *D. limbatus*.

54. CRAGIN, F. W.

Further Notes on the Cheyenne Sandstone and Neocomian Shales. Amer. Geologist, Vol. VII, pp. 179-181. Minneapolis. March, 1891.

"During the summer of 1890, and since my article 'On the Cheyenne Sandstone and the Neocomian Shales of Kansas,' * * * I have gathered some additional data touching these formations."

"* * * I have been shown a locality on the North Canadian or Beaver river, about longitude 100° 12′ W., where both the larger and smaller varieties of *Gryphæa pitcheri* occur in the Loup Fork Tertiary conglomerate, some of the specimens showing very little wear, and bearing witness to the former extension of the Neocomian over that region."

"Occurrences reported to me from points not far northeast of Tascosa, Texas, are probably referable to the Neocomian."

"I have also reconnoitered that portion of the 'Cherokee Outlet' and 'Panhandle of Texas' adjacent to the Cimarron river, and the Panhandle extension of the Santa Fe railway southwest to the main Canadian. Loup Fork Tertiary sandstone, or more commonly the sandy decomposition product of the same, cloaks the divides and their south slopes, resting in general directly upon 'red beds' * * * ; yet the data in hand leave little room to doubt that the lower Neocomian strata once prevailed from the western border of McPherson county, Kansas, * * * to the foundations of the Llano Estacado."

"By the courtesy of Prof. Hill, of the Texas Geological Survey, I have been able to traverse with him a course from Millsap, Texas, to Weatherford, and thence to Granbury, and thus to confirm his reference in 1889 (Ann. Rept. of Geol. Surv. of Ark., 1888, Vol. II, p. 115), of Nos. 5 and 6 of my Belvidere section to his Fredericksburg shale and Trinity sandstone, respectively."

"The paleontologic and lithologic identity of No. 5 of my Belvidere section with a certain shell-conglomerate occurring at Weatherford—the lowest known Gryphæa-bearing horizon of Texas—is such as to warrant me in asserting the essential chronologic equivalency of the two horizons."

Discussion of *Gryphæa pitcheri.*

"The Cheyenne sandstone may be regarded as the much abbreviated representative of the series of incoherent sandstones underlying the above mentioned Weatherford shell-conglomerate, and outcropping between Millsap and Weatherford in alternation with harder strata containing *Pleurocera, Nerinæa,* and other forms, to the most of which southern Kansas can show nothing similar. The upper and major portion of the basal stratum of friable ferruginous-yellow and white sandstone seen on Grindstone creek and its tributaries a little east of Millsap, resting upon the eroded Carboniferous—from the harder elements of which its basal conglomerate portion is derived—bears especial lithologic resemblance to a very common phase of the Cheyenne sandstone."

55. CRAGIN, F. W.

A Contribution to the Invertebrate Paleontology of the Texas Cretaceous.

Fourth Annual Rept. of the Geol. Surv. of Texas, 1892, Pt. II, pp. 139-294; plates xxiv-xlvi, inclusive. Austin, 1893.

Contents: Introduction. Discussion of Genera and Species.

Coelenterata—*Favia texana* sp. nov.

Echinodermata—*Ananchytes texana* sp. nov.; *Cidaris dixiensis* sp. nov.; *Cyphosoma volanum* sp. nov.; *Diplopodia hilli*, Clark; *D. streeruvitzii* sp. nov.; *D. taffi* sp. nov.; *D. texana*, Roem. Dumblea gen. nov.; *D. symmetrica* sp. nov. *Echinobrissus texanus*, Clark. *Enallaster inflatus* sp. nov.; *E. texanus*, Roem., *Epiaster electus* sp. nov.; *E. elegans*, Shum.; *E. elegans*, var. nov. *praenuntius*; *E. hemiasterinus* sp. nov.; *E. whitei*, Clark. *Goniopygus zitteli*, Clark. *Hemiaster texanus*, Roem. *Holaster completus* sp. nov.; *H. nanus* sp. nov.; *H. simplex*, Shum.; *H. supernus* sp. nov.; *Holectypus charltoni* sp. nov.; *H. planatus*, Roem.; *H. transpecosensis* sp. nov. *Leiocidaris hemigranosa*, Shum., *Orthopsis occidentalis* sp. nov.; *Pseudodiadema texanum*, Roem. *Pyrina bulloides* sp. nov.; *P. parryi*, Hall. *Salenia texana*, Credn.; *Cidaris*, sp.

Molluscoidea—

Bryozoa. *Biflustra brownii* sp. nov.; Porocystis gen. nov,. *P. pruniformis* sp. nov.

Brachiopoda. *Lingula shumardi* sp. nov.

Mollusca—

Lamellibranchiata. *Aguileria cumminsi*, White. *Anatina texana* sp. nov.; *A. tosta* sp. nov. *Arca galliennei*, var. nov. *tramitensis*; *A.* (*Trigonarca*) *siouxensis*, H. and M. *Astarte* (? *Stearnsia*) *acuminata* sp. nov. *Avicula leveretti* sp. nov.; *A. singleyi* sp. nov. *Cucullaea gracilis* sp. nov.; *C. gratioti*, Hill; *C. tippana*, Con.; *C. terminalis*, Con.; *C. transpecosensis* sp. nov. *Cypremeria ?excavata*, Mort.; *C. crassa*, Mk.; *C. gigantea* sp. nov.; *C. texana*, Roem. *Cyprina mediale*, Con.; *C. roemeri* sp. nov.; *C.* (*?Roundairia*) *streeruvitzi* sp. nov.; *C. texana*, Con. *Cytherea lamarensis*, Shum.; *C. leveretti* sp. nov.; *C. taffi* sp. nov. *Exogyra americana*, Marcou; *E. columbella*, Mk.; *E. drakei* sp. nov.; *E. ferox* sp. nov.; *E. hilli* sp. nov.; *E. laeviuscula*, Roem.; *E. paupercula* sp. nov.; *E. plexa* sp. nov.; *E. weatherfordensis* sp. nov. *Gervilliopsis invaginata*, White. *Gryphæa gibberosa* sp. nov. *Hippurites flabellifer* sp. nov. Holocraspedum gen. nov. *Homomya jurafacies* sp. nov.; *H. solida* sp. nov. *Inoceramus cumminsi* sp. nov.; *I. multistriatus* sp. nov. *Isocardia humilis* sp. nov. *Lima generosa* sp. nov.; *L. semilaevis* sp. nov. *Modiola filisculpta* sp. nov.; *M. jurafacies* sp. nov. *M. stonewallensis* sp. nov. *Opis texana* sp. nov. *Ostrea alifera* sp. nov; *O. alifera* var. nov. *pediformis*; *O. alternans* sp. nov.; *O. bella*, Con.; *O. bellaplicata*, Shum.; *O. camelina* sp. nov.; *O. carica* sp. nov.; *O. crenulimargo*, Roem.; *O. crenulimargo* var. nov. *stonewallensis*; *O. diluviana*, Linn.; *O. franklini*, Coq.; *O. lugubris*, Con.; *O. lyoni*, Shum.; *O. perversa* sp. nov.; *O. plumosa*, Mort.; *O. soleniscus*, Mk.; *O. subovata*, Shum.; *O. subspatulata*, Forbes. *Pholadomya ingens* sp. nov.; *P. postextenta* sp. nov. *Plicatula dentonensis* sp. nov.; *P. incongrua*, Con. *Protocardium pendens* sp. nov.; *P. stonei* sp. nov.; *P. subspingerum* sp. nov. *Pteria ?salinensis*, White. *Spondylus hilli*, sp. nov. *Tapes dentonensis* sp. nov.

CRAGIN, F. W.

Trigonia clavigera sp. nov.; *T. concentrica* sp. nov.; *T. securiformis* sp. nov.; *T. taffi* sp. nov.; *T. vyschetzkii* sp. nov. *Venus malonesis* sp. nov. *Vola bellula* sp. nov.; *V. catherina* sp. nov.; *V. duplicicosta*, Roem.; *V. wrightii*, Shum. *Yoldia septariana* sp. nov.

Gasteropoda. *Anchera modesta* sp. nov. Buccinatrix gen. nov. *B. regina* sp. nov. *Cerithium bosquense*, Shum.; *C. interlineatum* sp. nov.; *C. proctori* sp. nov.; *C. tramitenses* sp. nov. *Cinulia tarrantensis* sp. nov. *Cylindrites formosus* sp. nov. *Fusus graysonensis* sp. nov. *Natica humilis* sp. nov. *N. striaticostata* sp. nov. *Nerinea hicoriensis* sp. nov. *N. pellucida* sp. nov.; *N. volana* sp. nov. *Neritina apparata* sp. nov. *Neritopsis biangulatus*, Shum.; *N. tramitensis* sp. nov. *Pleurotomaria macilenta* sp. nov.; *P. robusta* sp. nov. *Rostellites pupoides* sp. nov. *Trichotropis shumardi* sp. nov.; *Turbinopsis septariana* sp. nov.; *Turritella coalvillensis*, Mk.; *T. renauxiana*, D'Orb.; *T. seriatim-granulata*, Roem. *Tylostoma ? mutabilis*, Gabb.

Cephalopoda. *Buchiceras inæquiplicatus*, Shum.; *B. swallowvi*, Shum. *Crioceras annulatus*, Shum. *Hoplites roemeri* sp. nov.; *H. texanus* sp. nov. *Nautilus texanus*, Shum. *Pachydiscus brazoensis*, Shum.; *P. complexus*, H. and M. *Placenticeras syrtalis*, Mart., var. nov. *cumminsi*. *Pulchellia bentonianum* sp. nov. *Scaphites septem-seriatus* sp. nov. *Schloenbachia leonensis*, Con.; *S. peruviana*, Von B.; *S. wollgari*, Mantell. *Sphenodiscus dumbli* sp. nov.; *S. emarginatus* sp. nov.; *S. lenticularis*, Owen; *S. roemeri* sp. nov.

Plates.

Serpula jonahensis sp. nov. based on illustration. *Ostrea roanokensis* sp. nov. based on illustration.

56. ——————

The Choctaw and Grayson Terranes of the Arietina. Colorado College Studies, 5th Ann. Pub., pp. 40-48. Colorado Springs, 1894.

"The 'ram's horn oyster,' *Exyogyra arietina*, F. Roemer, is the characteristic fossil of a column of sediments, the so-called Exogyra arietina marl, that in Hays, Travis and Williamson counties, Texas, consists mostly of calcareo-argillaceous, and more or less ferruginous marl, and attains a thickness of sixty to eighty feet, occupying the interval between the top of the Washita limestone of Shumard and the base of the Shoal Creek Limestone of Hill. * * * From Austin to the Red River valley, in Cook and Grayson counties, the Arietina becomes, as Taff has shown, gradually reduced in thickness and decidedly more calcareous. For this calcareous northern phase of the Arietina which, in the Red River valley, occupies the entire interval between the summit of the Pawpaw clays of Hill and the base of the Dakota sandstone, Hill has recently proposed the name, Main-street Limestone.

"The Main-street Limestone, however, consists of two members. Its dual character has been independently determined in the field by the present writer. But the members that compose it were first recognized as terranes by Taff in his second Report on the Cretaceous Area North of the Colorado

Cragin, F. W.

river, who corrolated the upper member with the Shoal Creek (Vola) Limestone." Pp. 40-41.

The lower of the two members is termed the Choctaw Limestone. Its occurrence. Fauna of Choctaw Limestone. "Perhaps the most marked paleontological characteristic of the Choctaw Limestone is the plentiful occurrence of *Terebratula Wacoensis* in association with *Exogyra arietina*." P. 42.

The second member, the Grayson Marls which rest conformably on the limestone above mentioned and are succeeded unconformably by the Dakota sandstone. Description of the Marls. Fauna. Table of the occurrence of fossils in the Terranes of the Main-street Arietina.

57. ——————

Descriptions of Invertebrate Fossils from the Comanche Series in Texas, Kansas, and Indian Territory.

Colorado College Studies, 5th Ann. Pub., pp. 49-68. Colorado Springs, 1894.

"The material described in this paper has been derived chiefly from the Arietina beds of Northern Texas, a small part of it coming from rocks of lower horizons and elsewhere. * * * " The Kiowa Shales, explanation of the term. For Choctaw limestone and Grayson Marl see preceding title.

Astroecœnia nidiformis, sp. nov. Kiowa Shales, Belvidere, Kansas. *Hemipedina Charltoni*, sp. nov. Choctaw Limestone, near Denison, Texas. *Pecten inconspicuus*, sp. nov. Pawpaw Clays, east of Denison. *Vola Fredericksburgensis*, sp. nov. Comanche Peak limestone. *Avicula dispar*, sp. nov. Grayson Marl, near Denison. *Inoceramus comancheana*, sp. nov. Duck Creek Limestone, northeast of Denison. *Inoceramus munsoni*, sp. nov. Duck Creek Limestone, northeast of Denison. *Nucula chickasaensis*, sp. nov. Comanche Peak Limestone, south of Overbrook, I. T. *Cardium quinordinatum*, sp. nov. Washita Limestone, near Georgetown. *Roudairia denisonensis*, sp. nov. Grayson Marl, Denison. *Pholadomya Ragsdalei*, sp. nov. Choctaw Limestone, southeast of Denison. *Homomya washita*, sp. nov. Grayson Marls, Denison. *Tellina subaequalis*, sp. nov. Pawpaw Creek, east of Denison. *Corbula crassicostata*, sp. nov. Kiowa Shales, Belvidere, Kansas. *Margarita Brownii*, sp. nov. Caprina Limestone, Travis county. *Neritoma Marcouana*, sp. nov. Kiowa Shales, Kiowa county, Kansas. *Solarium chickasaense*, sp. nov. Comanche Peak Limestone, near Marietta, I. T. *Turritella Denisonensis*, sp. nov. Choctaw Limestone, east and southeast of Denison. *Vanikoro propinqua*, sp. nov. Kiowa Shales, near Belvidere, Kansas. *Anchura kiowana*, sp. nov. Kiowa Shales, Clark county, Kansas. *Nautilus washitanus*, sp. nov. Common, Washita Limestone.

58. (——————)

The Columbian Exposition. Notes on some Mesozoic and Tertiary Exhibits. The United States Geological Survey.

CRAGIN, F. W.

Editorial Comment.

Amer. Geologist, Vol. XIII, pp. 185-189. Minneapolis, 1894.

That portion of the editorial relating to Texas paleontology is found on pp. 186-189. It consists mainly of a criticism of the determination of certain species on exhibition by the U. S. geological survey.

59. CUMMINGS, URIAH.

Art. American Rock Cement. Min. Resources of the U. S. 1895. Nonmetallic Products, except coal.

Seventeenth Annual Report of the U. S. Geological Survey, part III (continued).

(Rock Cement in Texas), p. 891. Washington, 1896.

In a table showing the "Product of Rock Cement in 1894 and 1895," Texas is credited as follows:

State.	1894.			1895.		
	Number of Works.	Barrels.	Value.	Number of Works.	Barrels.	Value.
Texas....................	1	12,000	$ 18,000	1	10,000	$ 17,000

60. CUMMINS, DUNCAN H.

Texas Gypsum Formation.

Science, Vol. XX, No. 516, p. 353. Dec. 23, 1892.

"The Texas beds extend over an area of upwards of six million acres. Extending from the north line of the State, south to the line of the Texas and Pacific Railroad, the beds vary in thickness from that of a sheet of paper up to seventy-five feet. The east line of the deposit passes Sweetwater, on the line of the Texas and Pacific Railroad in Nolan county. The west line passes about twenty miles east of the Staked Plains. The greatest thickness of these beds is about nineteen hundred feet."

Six forms of gypsum are described, viz.: selenite, rose, massive, radiated, fibrous, and alabaster. In addition there are gypseous marls and gypsiferous sandstones in great abundance.

61. CUMMINS, W. F.

Mining Districts in El Paso County.

Geol. and Scientific Bulletin, Vol. I, No. 2. Houston, June, 1888.

"There are two principal mining districts in El Paso county, one of them known as the Quitman Mountain district, and the other as the Diabolo district. The Quitman Mountain district is about eighty-five miles southeast of the city of El Paso, and is on the south side of the

Cummins, W. F.

G. H. & S. A. R. R. The Diabolo Mountain district is about one hundred and twenty-five miles east of El Paso. There are some other localities in the county where there has been considerable prospecting done, and where there will be found valuable properties no doubt, but for the present nothing is being done to develop them. The Quitman district so far has produced principally argentiferous galena; occasionally gold has been found, but not in paying quantities. The mineral generally occurs in veins traversing the country rocks. These veins are from a few inches to several feet in width. The country rock is usually granite or porphyry. The lower foothills are Cretaceous limestone. The vein material is sometimes quartz, sometimes carbonate of lime, and in other places it is carbonate of iron. There are some good veins of mineral in contact veins. These contacts are between porphyry and limestone. The highest mountains are composed of igneous rocks, while the limestones are at the base of the mountains and dip at various angles, according to their proximity to or remoteness from the general line of upheaval. The limestones on the north side of the mountains belong to the Cretaceous formation. Elsewhere I did not examine them sufficiently to determine their geological age.

* * * * * * *

"The other district I have mentioned, the Diabolo, is about eight miles north of the line of the T. & P. R. R. The most of the ore taken from that district has been shipped from Carrizo Station. The ores of this district are copper and silver. No galena, so far as I know, having been found here. The ore occurs in well defined fissure veins, and in contacts. The veins are found traversing the country rock almost perpendicularly in a northeast and southwest course. The country rock is a fine grained red argillaceous sandstone, massive, showing no lines of stratification, breaking with conchoidal fracture, and much broken up by atmospheric influences. It has no fossils. It is overlaid by the rocks of the Carboniferous formation, but never having seen any of the underlying strata, I have been unable to determine to what geological formation this red sandstone belongs. The copper ores are gray copper (tetrahedrite), copper pyrites, malachite, and azurite. These ores all carry more or less silver. In the gray copper ores the silver is native, and yields a very large per cent."

62. ——————

The Carboniferous Formation in Texas.

Geol. and Scientific Bulletin, Vol. I, No. 3. Houston, July, 1888.

Extract: "I have seen the Carboniferous rocks as far south as Marble Falls, in Burnet county. The eastern boundary of this formation begins at a point on Red River, near the northeast corner of Montague county, thence through Wise county, crossing the Texas and Pacific Railroad near the town of Millsap, and thence in a southwestern direction to the Colorado river. The western boundary of the formation begins at a point on Red River, near the northwest corner of Montague county, thence southwestwardly, crossing the Texas and Pacific Railroad near Baird, and thence to the Colorado river, near the town of Ballinger. This coal field

CUMMINS, W. F.

is a continuation of the coal fields of the Indian Territory, Arkansas and Missouri. The strata are composed, as in other States, of limestones, sandstones, clay beds, shales and coal beds. The characteristic fossils of the formation are very numerous, and in a fine state of preservation. In the northern part of this field the strata dip at a slight angle to the northwest. In the middle portion the dip is at a small angle to the southwest. In the extreme southern field the dip is almost directly to the west."

* * * * * * *

"There is a western Carboniferous field which is entirely beyond the Pecos river. It is found in the Guadaloupe mountains, not only on the eastern side, as was said by a writer in the June number of the *Bulletin*, but on all sides of them. I have seen the rocks and fossils of the Carboniferous period in all the mountains north of the Texas and Pacific Railroad, in El Paso county. The formation does not extend very far on the south side of said road. The mountains just north of the city of El Paso are, on their south end, composed entirely of Carboniferous rocks, and give an exposure of nearly eight hundred feet of the strata. The strata of this western field are very much disturbed, and dip at various angles and in various directions, owing to the proximity or remoteness of the locality to the line of upheaval. On the highest mountains I have seen nothing on top of the Carboniferous, but the foothills are composed of the Cretaceous, and in some places show the same disturbance or inclination of strata as the underlying Carboniferous. This western Carboniferous formation is entirely barren of coal, and I am of the opinion that it is useless to look for coal in the Carboniferous rock of the western district."

63. (——————)

(The Western Area of the Carboniferous in Texas.)

Note.

The Amer. Geologist, Vol. II, p. 138. Minneapolis, Oct., 1888.

"According to W. F. Cummins, the western area of the Carboniferous in Texas is entirely barren of coal, and in the foothills the overlying Cretaceous is found to dip conformably with the Carboniferous."

64. ——————

Report of Geologist for Northern Texas.

Texas Geol. and Min. Surv. First Rept. of Prog., 1888, pp. 45-53. Austin, 1889.

An account of the work begun October 1, 1888, which was mainly devoted to the Carboniferous formation. Observations confined to that part of the State north of the Texas and Pacific railway and east of the Pecos river. The Carboniferous formation including the Permian. Report devoted to Upper and Lower Coal Measures. Direction of the Carboniferous-Cretaceous contact on the east; of the Carboniferous-Permian on the west. Thickness of Carboniferous strata. Timber growth.

CUMMINS, W. F.

Dip of strata. Coal. No connected scientific observations regarding the number or thickness of the seams. Fallacious notions. Extent of Coal Fields. Number and thickness of seams. Counties. Difficulty of distinguishing coal seams. Seams 2 and 1. Lake Mine. Carson and Lewis mine. Fossils of the adjoining strata. Section of strata. Gordon mine. Thickness of seam. Coal of poor quality. Large p. c. of sulphur. Section of strata. Johnson mine. Upbending of strata. Thickness of seam. Palo Pinto mine. This mine also on seam 1. Seams 3, 4, 5, and 6. Mine at Cisco on seam 7. Thickness. Not profitable. Seams 8 and 9. Decatur mine. Thickness of seam. Stephens mine. Thickness of coal. Water in stratum above seam. Economic minerals. Iron ore. Building stone. Limestones and sandstones. Clays. Lime. Conglomerate. Gravel. Mineral waters. Natural gas. Soils classified. Water supply.

65. ———————

Report of.

First Ann. Rept. Geol. Surv. of Texas, 1889, pp. lxxxii-lxxxiii. Austin, 1890.

Administrative report. Instructed to make a detailed section of the Carboniferous formation of Central Texas. Took the field at Lampasas, March 13, with C. C. McCulloch, Jr., as assistant. General route followed. Further instructions to make a similar investigation of the Permian area. The Carboniferous-Permian contact. Route. N. F. Drake, topographer. Difference in altitude between the lowest and the highest Permian beds.

66. ———————

The Southern Border of the Central Coal Field.

First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 143-182. Austin, 1890.

Contents: Descriptive Geology.—Introduction. Cretaceous system. Carboniferous. Conglomerate. Petrified wood. Caves. Conclusions. Economic Geology.—Coal. Gas. Oil. Iron. Aragonite. Strontianite. Building stone. Marble. Clays. Lithographic stone. Soils. Water.—Mineral water, salt water and water power. Irrigation. Rainfall. Temperature. Timber.

"The exploration upon which this report is based extended over parts of Lampasas, San Saba, Coleman, McCulloch, Concho, and Tom Green counties. The object of the trip was to secure such general information regarding the section as would indicate the special lines of work that could be most advantageously pursued in the detailed survey of this region.

"During the present expedition strata belonging to the Silurian, Carboniferous, Cretaceous, and Recent systems have been observed, some of which will be more fully mentioned under separate headings, but their boundaries must be left for more detailed work.

"The different formations have been identified either by their fossils or by their relative positions in regard to other known strata. There is great uniformity of structure in the individual strata of the several for-

Cummins, W. F.

mations over the entire field; so much so that one becoming familiar with the characteristics of a stratum in one place need have little trouble in recognizing it elsewhere when found.

"The strata of the Paleozoic group as observed along the route have a general and uniform dip to the north and northwest, with little or no disturbance, except in one or two instances, which are noted. The Mesozoic strata, on the contrary, have a general inclination to the southeast.

"Few evidences of faults or folds of the strata in any of the formations were seen, except when they are in contact with the eruptive rocks. The alternations of limestone, sandstone, and shales in the various formations show that the periods of their deposition were attended with alternating conditions of subsidence and elevation.

"The rocks of the Cretaceous system are found in contact with strata of both the Carboniferous and Silurian, showing that the Silurian and Carboniferous strata had been tilted to the northwest before the Cretaceous period; and as the Cretaceous is found on or in contact with every stratum of the Carboniferous and Permian, from the highest to the lowest, there is little doubt that the Cretaceous strata at one time extended continuously from the foot of the Staked Plains to the Cretaceous beds on the east, and that the present exposure of the underlying Paleozoic group is due to their subsequent erosion.

"The Cretaceous formation of this part of the State belongs entirely to the Lower or Comanche series. The beds have a thickness of about 200 feet wherever seen, except on the upper South Concho river, where the thickness increases to about 400 feet." Pp. 145-146.

"The Carboniferous system extends over the largest part of the country examined during this trip, and to it the most of the time was devoted.

"No attempt is here made to separate the Subcarboniferous from the Carboniferous. In fact, I am not certain that the Subcarboniferous formation occurs. The strata of the entire series, so far as I observed them, are conformable, and the fossils found in the lower part of the formation were not characteristic of the Subcarboniferous, but are those which are for the most part embraced in the fauna of the coal measures. I am certain, however, that there is a section at least 400 feet thick, lower than the strata of the coal measures which are found in the northern part of the State.

"The Permian formation was clearly distinguished overlying the coal measures on the west.

"The general dip of the strata of this system is to the northwest at about 30 feet to the mile, except near Lampasas, where the dip is to the northeast, which may be accounted for either by the existence of an anticlinal in the western part of Lampasas county, or possibly by faulting.

"The strata of the Carboniferous are composed of limestones, sandstones, clay beds, and shales with three or more beds of coal. On top of the measures in many places is a bed of conglomerate similar to that found overlying the coal measures in the northern part of the State.

"The measures are about 1600 feet thick, so far as examined, although their upper part was not reached. In many places the strata are so deeply covered up with drift that it was impossible to get a continuous

CUMMINS, W. F.

section, and the thickness is, therefore, estimated by the known dip of the strata, where a section could not be made by actual measurement. Many sections were made at different localities, with the hope of being able to secure a continuous section, but there are gaps that can only be filled by estimates of thickness, based on dip and the distance occupied by the wanting section. Enough, however, has been done to give a very correct idea of this formation, which can be worked out more in detail in the future." P. 147.

67. ——————

The Permian of Texas and its overlying Beds.

First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 183-197. Austin, 1890.

Contents: Description. The Wichita beds. The Clear Fork beds. The Double Mountain beds. Overlying formations.—Dockum beds. Blanco Canyon beds. Economics.—Soils. Fertilizers. Water. Rainfall. Building material. Timber. Salt. Copper. Iron. Gypsum.

"It is only intended in this report to give a resume of the work done in the Permian formation in Texas, as well as an outline of the leading characteristics of the formation as I have observed them, and also to draw some conclusion in regard to the economics of the district, leaving to a future report the work of giving these facts a fuller and more extended explanation.

"The Permian formation in Texas embraces all that territory situated between the Coal Measures on the east and the base of the Staked Plains on the west, except a line of disconnected hills extending from Comanche county to Big Springs, ranging along the south side and almost parallel with the line of the Texas and Pacific Railroad. These hills, at least in their upper members, belong to the Comanche series of the Cretaceous. There are also a few isolated hills north of the line of the Texas and Pacific Railroad, such as the Double Mountains in the western part of Stonewall county, whose tops are capped with the rocks of the Cretaceous.

"The extreme southern limit of the Permian formation in Texas is a few miles south of San Angelo, in Tom Green county. In that locality it is only a few miles wide. It is covered on both the east and west sides in that vicinity by the Cretaceous. The formation widens constantly to the northward, until at its broadest part it is not less than 150 miles wide.

"The stratification is conformable with that of the underlying Carboniferous, and has a general dip to the northwest.

"The area underlaid by these beds is, as one would naturally suppose from the character of materials of which they are made up (mostly sands and clays, with interbedded sandstone and limestone), a beautiful rolling country, cut here and there by smaller or larger creeks or rivers, with little timber save along the streams, with broad valleys in places, and at others precipitous canyons. Only where the heavy bedded limestones of the middle division occur, or in the massive gypsum deposits of the upper beds, do we find any bluffs of considerable height.

"This formation was first reported as Permian, in 1852, by Professor

CUMMINS, W. F.

Jules Marcou, who was at that time geologist with the Pacific Railroad Survey, from Fort Smith to the Pacific Coast."

* * * * * * *

"The estimated thickness of the strata of the Permian is about 2800 feet. A detailed section has been made across the formation, but a general section has not yet been made up so as to determine the exact thickness of the strata.

"The dip of the strata is about 40 feet per mile, north 45 degrees west. At one locality the dip was calculated by an actual instrumental measurement of ten miles, at another place of five miles, and at a great number of places of smaller distances, so that the dip of the strata is well determined. It is only at the western edge of the Double Mountain beds that there is any increase in the dip, and in that locality the strata are so much distorted and folded that it was difficult to get long lines of observation, so that the general dip could be determined with anything like certainty. There were no faults found nor any evidence of eruptive disturbances.

"For convenience the strata are here divided into three beds, whose correlation with the Permian formation in other localities will not be attempted in this report.

"Beginning with the lowest or eastern, we have:

1. The Wichita Beds.
2. The Clear Fork Beds.
3. The Double Mountain Beds.

"These beds, from the nature of their constituents and of their formation, so grade into one another that the exact line of demarkation is very obscure, even if it can be found at all. This is no less the case with the line between the Permian and the underlying Coal Measures. A separation of these series from the Coal Measures is, however, based, first, on lithological differences; second, on fossil contents.

"The strata of the Coal Measures are not persistent in character on the line of contact between that formation and the overlying Permian; and yet in each locality there seems to have been a continuous sedimentation. On the line of contact between the Coal Measures and the Wichita Beds, from Red River South to the Brazos, there are only sandstones in both strata; yet there was a considerable lapse of time between their deposition, as is shown by the fact that the limestones, which at other places constitute the highest beds of the Coal Measures, and which at those places overlie the sandstones, are entirely wanting along the line of this contact. Further south, on the line of contact between the Coal Measures and the Clear Fork Beds there are only limestones, which are apparently continuous in sedimentation, yet we know that such is not the case, for only a few miles north of this line of observation we find that the Wichita Beds of the Permian underlie these Permian limestones.

"The fact of the want of continuity of sedimentation between the Coal Measures and the Clear Fork Beds is shown also by the fauna of the two beds. The fauna of the Coal Measures limestones, which lie directly below the limestones of the Clear Fork Beds, is abundant and consists of such characteristic forms as *Productus semi-reticularis, Chætetes gracilis, Schizodus wheeleri, Allorisma sub-cuneata, Hemipronites crassus*, etc., but they almost fade out before they reach the top of the series, and only a few

CUMMINS, W. F.

species pass up into the overlying limestones of the Permian, and other species of newer type take their places. The same may be said of the fauna on the line of contact between the Coal Measures and the Wichita Beds.

"The Double Mountain Beds do not reach the Coal Measures at any point, but lie conformably upon the Clear Fork Beds. The Clear Fork Beds are the only ones that reach the southern extremity of the Permian district.

"The Permian Beds are overlaid on the west by the Jura-Trias (?) and Cretaceous. It is evident from the remaining buttes and ranges of Cretaceous hills that the entire Permian and Carboniferous strata were at one time covered by the Cretaceous, at least along the southern portion of the district. Erosion has again removed these strata and exposed the older beds." Pp. 185-187.

68. ———— and LERCH, DR. OTTO.

A Geological Survey of the Concho Country, State of Texas. Amer. Geologist, Vol. V. pp. 321-335. Minneapolis, June, 1890.

The country takes its name from the Concho river. Situation: West of the 100th meridian and between the 31st and 32d parallels of north latitude. San Angelo, the chief town. Drainage and topography: North Concho river; Main Concho; Spring and Dove creeks; South Concho and Colorado rivers. Source and fall of the streams. Relation of topography to geology. River valleys, plateaus, etc. Geology. Alluvium. Drift. Local beds of conglomerate. Lacustrine Deposits. The Cretacic. Position. Dip. Topography. Character of deposits. The group here exposed is called Comanche series by Hill. Section on South Concho, 20 miles south of San Angelo. List of fossils. The Permian: Position and dip; Commingling of Carbonic and newer forms of life; Color of deposits and other Characters; Gypsum beds along the Colorado river. Estimated thickness of the Permian. Section of the Permian; List of fossils. Economic Geology. Climate. Movement of the air. Table. Table showing the average temperature together with the highest and lowest points recorded during each month since April, 1868, at Fort Concho, San Angelo. North winds. Temperature. Rainfall. Table showing rainfall at San Angelo since April, 1868. Water of the rivers. Subterranean water. Depth. Sections of wells. Artesian wells. Salt and other mineral wells. Soils. Building material. Quicklime. Cement. Clay. Irrigation. Grasses. Timber.

69. ————

Report of.

Second Ann. Rept. of Geol. Surv. of Texas, 1890, pp. xcviii-ci. Austin, 1891.

Administrative Report on work done between January 1, and December 31, 1890, which began at Dockum, Dickens county, and ended at Lampasas. Route followed. Area surveyed Permian and Carboniferous. Re-

CUMMINS, W. F.

connaissance of the Wichita Mountain country, Indian Territory. The opinion is expressed that the Dockum Beds are the same as the Shinarump Beds of Hayden, a member of the Triassic formation in Arizona, and that the beds constituting the upper part of the Staked Plains are Tertiary. No reason to change opinion that all the strata from the Coal Measures to the Dockum Beds belong to the Permian. Mr. N. F. Drake had charge of the topographic work.

70. ——————

Report on the Geology of Northwestern Texas.
Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 357-552; 14 plates; map; 6 figures. Austin, 1891.

Contents: Introduction. Part I. Stratigraphic Geology.—Silurian; Devonian; Sub-Carboniferous; Carboniferous; Permian; Triassic; Tertiary. Part II. Economic Geology—Coal; Natural Gas; Salt; Copper ore; Iron ore; Gypsum; Building stones; Building materials; Agriculture; Archæology. Part III. Description of Counties.—Young county: Coal; Topography and Drainage; Geology; Soils, Timber and Water; Building Material; Iron ore; Salt. Montague county: Topography and Drainage; Geology; Soil; Timber, Water, and Building Material; Coal; Copper and Galena. Jack county: Drainage and Topography; Geology; Soil, Timber and Water; Building Material; Coal. Wise county: Topography and Drainage; Geology, and Soil; Timber, Water, and Building Material; Coal; Other Minerals. Parker county: Coal. Palo Pinto county: Topography and Drainage; Geology; Soil and Timber; Water and Building Material; Natural Gas; Coal. Stephens county: Topography and Drainage; Geology; Soil; Timber and Water; Coal. Brown county: Topography and Drainage; Geology; Soil; Timber, Water and Building Material; Oil; Coal. Eastland county: Coal. Coleman county: Topography and drainage; Geology; Soil, Timber, and Water; Building Material; Oil and Natural Gas; Coal. Appendix. *Hadrophyllum aplatus*.

"The following table will show the formations in this portion of Texas, as I have observed them, as compared with the table taken from Dana's Manuel of Geology, which will give a definite idea of what I intend to represent by the various divisions and subdivisions:

Dana.	Texas.
Recent	Recent.
Tertiary	Tertiary.
Cretaceous	Cretaceous.
Juriassic	?
Triassic	Triassic.
Permian	Permian.
Carboniferous	Carboniferous.
Sub-Carboniferous	?
Devonian	
Silurian	Silurian.

"The above table gives the geological formations of the northwestern part of the State as I now understand it. I have confined my work largely to

CUMMINS, W. F.

the Permian and Carboniferous formations, giving only such attention to the other members of the section as was necessary to determine the relation of the Permian and Carboniferous formations to the overlying and underlying series, and to enable me to determine with accuracy the extent of these two formations in this part of the State.

On Plate VI, I have given a columnar section of the strata (higher than the Devonian) in northwestern Texas, with the provisional divisions which I have made of them." Pp. 359-360.

PLATE VI.

(*Without the conventional signs indicating the character of the deposits.*)

	Thickness.	DIVISIONS.
Tertiary.	200	Blanco Canyon.
Triassic.	125	Dockum.
Permian.	2075	Double Mountain.
	1975	Clear Fork.
	1800	Wichita.
Coal Measures.	1180	Albany.
	840	(Coal Bed No. 7.) Cisco.
	930	Canyon.
	3000	Strawn.
	1000	(Coal Bed No. 1.) Millsap.
	140 220	..........Bend..........

"The Silurian lies along the southwestern border of the Carboniferous * * * ." P. 360.

"The Devonian is entirely wanting along the lines of contact between the Carboniferous and the older rock, so far as I have been able to determine. I have not seen this formation anywhere in the State, yet it may exist." P. 360.

"From all the evidence I have been able to secure in the course of my work in this district I am forced to the conclusion that up to the present no Sub-Carboniferous rocks have been discovered." P. 367.

71. ————————

Report of (for 1891).

Second Report of Progress, Geological Survey of Texas, 1891, pp. 27-42. Austin, 1892.

CUMMINS, W. F.

Contents: Introduction. Boundary of the Staked Plains. Topographic Features. Geology of the Staked Plains. Geological Features West of the Staked Plains. Water Supply: Lakes, Springs, Streams. Water north and west of the Staked Plains. Wells. Artesian Water on the Staked Plains. Section (145 feet). Artesian Water west of the Pecos River. Minerals. The Trinity sands as a probable source of Artesian Water supply. Agriculture. Rainfall. Irrigation.

"The territory embraced in this resume includes those portions of the State of Texas and Territory of New Mexico known as the 'Llano Estacado, or Staked Plains.'

"It is intended only to show such results of my geological observations, as to the general character and economic resources and capacities of the district, as are considered definitely settled at the close of the field work, and it is intended to follow this brief statement with a more amplified and specific report in the future." P. 27.

72. ——————

The Texas Meteorites.

Transactions of the Texas Academy of Science, Vol. I, No. 1, pp. 14-18. Read April 2, 1892.

"In the earlier part of this century several large fragments of metallic iron were discovered in the area now known as Texas, which have been given the collective name of The Texas Meteorites, and, both on account of their size and composition, are as interesting as any that have been found. As the history of the finding of these masses is not very well known, I propose to give a brief detail of it in this paper."

One of these fragments known as the Texas Meteorite, is in the Yale Museum, another is in the geological and mineralogical collection of the University of Texas, and the third, at one time in the Texas State collection, has disappeared.

73. ——————

Review of R. T. Hill's Report on Artesian Water in Texas.

Pamphlet of 44 pages; no date (1892?).

A criticism rather than a review.

74. —————— and DUMBLE, E. T.

See Dumble and Cummins.

The Double Mountain Section.

Amer. Geol., Vol. IX, pp. 347-351; 1 pl. Minneapolis, June, 1892.

75. ——————

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp, lv-lvii. Austin, 1892.

Administrative Report of the Geologist for Northern Texas. The Field work for 1891 "was to trace the Carboniferous formation to its farthest

CUMMINS, W. F.

outcrop in Central Texas, and to determine the northern extension of the Cretaceous strata along the eastern escarpment of the Staked Plains, as well as to trace and determine the extent of the Dockum and Blanco Canyon beds and their relation to the underlying strata." The question of Artesian water on the Staked Plains. Personnel of the party. N. F. Drake, Topographer and Assistant Geologist; D. H. Cummins, Assistant Geologist. Route followed.

76. ——————

Report on the Geography, Topography, and Geology of the Llano Estacado or Staked Plains.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 127-200; 3 plates; 1 figure; map by W. F. Cummins and N. F. Drake. Austin, 1892.

Contents: Origin of the Name (Llano Estacado). Topography: Canyons; Sand Hills. Geology: Previous Work (Marcou, 1853; George G. Shumard, 1855; Blake, 1854; Cummins, 1889; Cummins, 1890); Work of the Past Season: (Sections made at various points along the route); Quaternary; Tertiary; Cretaceous; Triassic. (See also Stratigraphy of the Triassic Formation in Northwest Texas, by N. F. Drake). Economic Geology: Water; Lakes and Pools; Springs; Artesian Water. Description of Counties: Armstrong, Borden, Bailey, Briscoe, Cochran, Crosby, Castro, Dawson, Deaf Smith, Floyd, Gaines, Garza, Howard, Hockley, Hale, Lynn, Lamb, Lubbock, Oldham, Parmer, Potter, Randall, Swisher, Terry, Yoakum, Midland, Rector, Martin. Agriculture: Soils, Natural Growth, Climate, Rainfall, Fruit Growing, Vineyards, Prunes. Fuel.

"The name Llano Estacado, or Staked Plains, is applied to the high plateau in the northwestern part of Texas and eastern New Mexico. It is situated between 100 and 103 degrees west longitude, and 30 and 35 degrees north latitude. The plateau terminates abruptly on three sides, the east, north, and west, in bold, precipitous escarpments ranging in height from one hundred and fifty to four hundred feet. On the south side the descent is more gradual, and the boundary not so well defined. It is but a remnant of a once very extensive area, reaching from its present terminus on the south far to the northward, and from the Guadaloupe Mountains on the west to an unknown shore-line east of its present limit, as is clearly indicated by the extensive plains now lying north beyond the Canadian river, east between the headwaters of the Colorado, Brazos and Red rivers, and west beyond the Pecos. At present the plateau extends irregularly one hundred and sixty-five to two hundred miles from east to west, and about two hundred miles from north to south.

"The following is a more definite statement of the boundary of the area, taken from observations made during the past year's field work: Beginning at Big Springs, in Howard county, north to Gail, in the center of Borden county; thence north to Double Mountain Fork of the Brazos, near where the west line of Garza county crosses the river; thence northwest to Salt Fork of the Brazos, near the south line of Crosby county; thence northeast and north, passing fifteen miles west of Matador, passing Con-

CUMMINS, W. F.

nellee's peak, and crossing Pease river to the Quitique ranch. At ten miles further north the foot of the Plains turns almost abruptly west, caused by the erosion of the Palo Duro canyon. The high plateau can be seen to the northwest at about twenty miles distance; thence almost directly north, crossing the Fort Worth and Denver City Railroad at Goodnight, and thence north to a few miles south of the Canadian river; thence turning westward parallel with the Canadian river and at a distance of from ten to twenty miles from it, trending southward to the west line of Texas, in Oldham county; thence a little south of west to a point south of Tucumcari mountain, in New Mexico; thence westward about twenty miles to the northwest corner of the Plains; thence a little east of south, parallel with the Pecos river, and at a distance of twenty-five to thirty miles east of it, to the Horsehead crossing, at the southeast corner of Ward county.

"Within these limits is embraced the territory of the Staked Plains, except that of the southern extension, which can hardly be determined, from the fact that the surface of the country descends so gradually in that direction."

* * * * * * *

"The Staked Plains is one immense plateau with a gentle inclination from northwest to southeast. It is so level apparently as to produce the peculiar appearance of being up-hill in every direction, and its inclination is only determinable by instrumental measurements. The following altitudes show the gradual slope:

Clarendon, east of the northeast corner of the Plains...........	2734 feet.
Amarillo, on the edge of the Plains in northeast...............	3630 feet.
Top of the Plains at Fossil Creek, extreme northwest...........	4520 feet.
Top of Tucumcari mountain, west of last point.................	4720 feet.
Midland, in southeast, on Texas and Pacific Railroad...........	2780 feet.
Warfield, west of Midland, on Texas and Pacific Railroad........	2875 feet.
Odessa, west of Warfield, on Texas and Pacific Railroad........	2900 feet.
Duro, west of Odessa, on Texas and Pacific Railroad............	3100 feet.
Monahan's west of Duro, on Texas and Pacific Railroad........	2600 feet.
Crossing on Pecos river, on Texas and Pacific Railroad..........	2590 feet.

"Besides the canyons which traverse the Plains in several directions, there are several permanent lakes containing both salt and fresh water, and depressions in which rain water collects and stands for several months at a time. The only other diversity breaking the wide monotonous level are some drift sand-hills raised by the winds in the southwest." Pp. 129-133.

77. ———————

Notes on the Geology of the Country west of the Plains.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 201-223. Austin, 1892.

Contents: Tucumcari, New Mexico. (Extracts from Marcou and Hill bearing upon the Jurassic Age of the Tucumcari Beds. Discussion.) Valley of the Pecos. Carboniferous; Permian; Triassic; Cretaceous; Ter-

CUMMINS, W. F.

tiary. Economic Geology. Irrigation in the Pecos Valley. Soils and Waters of the Pecos Valley.

"In the prosecution of my work as Geologist for Northern Texas on the State Geological Survey, I found myself within a few miles of the locality [Tumcari, N. M.], and as it was a matter of interest to science in general, and to Texas geology in particular, I went there and made examinations of the strata constituting the Tucumcari beds and their relation to the surrounding strata. I made a large collection of the invertebrate fossils, as well as some of the fossil flora." P. 203.

"The reason for referring the Tucumcari beds to the Washita division of the Cretaceous is based upon the paleontology of the beds. During my explorations in that vicinity, I collected a great number of fossils, which are now in the museum at Austin. While the lithological character and stratigraphical position of beds in certain cases may be very important factors in determining the age of the strata, yet it seems to me, where paleontological evidence can be had, it is by far the most conclusive.

"In 1861, Marcou wrote and published 'Notes on the Cretaceous and Carboniferous Rocks of Texas,' in the Proceedings of the Boston Society of Natural History, Vol. VIII, January, 1861. In that article, after reviewing what Dr. Benjamin Shumard had written about Marcou's identification of the fossils found by him at Tucumcari with European Jurassic fossils, he says: 'I can only express the wish that when Dr. Shumard goes to Pyramid Mount he may find more fossils than I did, and if any of them are Cretaceous and below the *Gryphæa tucumcari* bed, I am ready to yield to such proof.'

"I did not find the Cretaceous fossils below the *Gryphæa* beds, but I found them in the beds, associated with the fossils found and described by Marcou. I believe if Marcou had seen the fossils I have collected he would not have hesitated to place the Tucumcari beds in the Cretaceous.

"The following is a list of the fossils collected by me from the Tucumcari beds in the vicinity of Tucumcari and Pyramid mountains.

Gryphæa dilatata, var. *Tucumcari*, Marcou.
Ostrea marshii, as determined by Marcou.
Gryphæa pitcheri, Morton.
Exogyra texana, Roemer.
Ostrea quadriplicate, Shumard.
Trigonia emoryi, Con.
Cardium hillanum, Sow.
Cytherea leonensis, Con.
Turritella seriatim granulata, Roem.
Pinna, sp.
Ammonites.
Pecten.

"These fossils at once show the age of the strata from which they were taken, leaving out of consideration for the present the first two in the list.

"The *Exogyra texana*, Roem., is found only in the Cretaceous, extending from the base of the Fredericksburg division into the Washita division.

CUMMINS, W. F.

Neither it nor its congener in Europe has ever been reported from the Jurassic.

"*Ostrea quadriplicata*, Shumard, is very numerous in the Washita division of the Cretaceous, and has never been found elsewhere. The *O. crenulinaryo*, Roemer, which is a very similar though specifically distinct form, comes from a lower division.

"*Trigonia emoryi*, Conrad, has been found in the Washita division of the Cretaceous.

"*Cardium hillanum*, Sowerby. This fossil has been reported from the Washita division.

"*Cytherea leonensis*, Conrad, is a Cretaceous fossil found only in the Washita division.

"*Turritella seriatim granulata*, Roem., is a Cretaceous fossil described from the Fredericksburg division.

"*Gryphæa pitcheri*, Morton, ranges from the middle of the Fredericksburg division to the top of the Washita division. This fossil is so different from the *G. dilatata*, var. *Tucumcari*, Mar., that notwithstanding they are found in the same bed, there was not the slightest difficulty in distinguishing one from the other.

"The only representative of the fossil flora we found was in the sandstone above the bed of blue clay, bed 'F' of Marcou's section. * * *

"This single specimen, taken from these beds, even if there was no other, is sufficient to establish the fact that the strata are no older than the Cretaceous. It is true that, as a general thing, the whole of a flora or fauna of strata ought to be examined before one can say definitely the age to which the strata belong, yet there are cases when the sub-divisions may be definitely determined by a single specimen. This matter is so clearly stated by Lester F. Ward in a late paper that I quote the following extract:

" 'The great types of vegetation are characteristic of the great epochs in geology. This principle is applicable in comparing deposits of widely different ages where the stratigraphy is indecisive. For example, in rocks that are wholly unknown even a small fragment of a carboniferous plant proves conclusively that they must be Paleozoic, or a single dicotyledonous leaf that they must be as late as the Cretaceous.'

"While the Jurassic and Cretaceous are not widely separated, and both are in the Mesozoic, yet some of the plants are so widely different that a single specimen would be sufficient to determine that the age was no earlier than the Cretaceous." Pp. 208-209.

78. ——————

"The Coal Fields of Texas."

Manufacturers' Record, Baltimore, March 10, 1893, pp. 112-113.

This article is mainly a criticism of Professor Hill's statement regarding "The Coal Fields of Texas," as published in the Mineral Resources of the United States for 1891 (Washington, 1893), and reprinted in the above journal for Jan. 13, 1893.

79. CUMMINS, W. F.
Tucumcari Mountain.
Amer. Geologist, Vol. XI, pp. 375-383. Minneapolis, June, 1893.

Location of Tucumcari Mountain. Confusion as which butte should bear the name of Big Tucumcari. The author endeavors to show that Prof. Marcou was in error in his designation, and that his claim of priority in the matter of names is invalid. A plate gives a fac-simile of Marcou's map.

80. ——————

See Dumble, E. T., and Cummins, W. F.
The Kent Section and Gryphæa Tucumcari, Marcou.
Amer. Geologist, Vol. XII, pp. 309-314. Minneapolis, Nov., 1893.

81. ——————

Notes on the Geology of Northwest Texas.
Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 177-238; 5 plates of sections. Austin, 1893.

Contents: Introduction. General Geology: Seymour Beds; Wild Horse Creek; Pecos Valley; Lake on Plains; Tule Ranch; Tule Canyon; Forks of Groesbeck; Good Creek; Three miles East of Kiowa Peak; McDonald's Creek; List of Pleistocene and Recent Shells; Tabular View of Occurrence of Shells. Tertiary: Conditions of the Country at the beginning of the Tertiary; Tule Division; Blanco Beds; Goodnight Division; Loup Fork. Cretaceous: Localities of Fossils. Permian: Wichita Division; Clear Fork Division; Double Mountain Division. Economic Geology: Copper.

"In submitting this report of the work done during the past year, I have thought it advisable to give a brief itinerary of the trip, in order to more definitely describe the localities visited and show their relation to each other.

"It had been demonstrated during my previous trip to the Staked Plains that there were different epochs of the Tertiary represented in the strata, and that a correct understanding of their relations could only be secured by a systematic collection of the fossils and a complete stratigraphic section. It was known that the Loup Fork beds, as well as their recognized fossils, occurred in places along the Canadian river, in the northern part of the Panhandle of Texas; that the Blanco beds, a terrane higher than the Loup Fork, were at Blanco Canyon; and that a still newer formation than the Blanco was situated to the west; yet their exact location and extent had not been definitely determined.

"It was also desirable to have a more extensive collection from the Triassic formation, of which the principal outcrop in Texas is at the base of the eastern escarpment of the Staked Plains. I was also instructed to make a more extensive collection of the fossils from the various horizons of the Permian strata, giving special attention to the invertebrates and to the flora.

CUMMINS, W. F.

"The route of travel was, therefore, selected so as to enable me to make consecutive observations of the stratigraphy of the Triassic, to visit the several localities where the Tertiary fossils were known to exist, as well as other localities likely to furnish fossils of that formation, and at the same time to collect fossils from the Triassic without making a special trip for that purpose, and then be in a position to go into the Permian with as little travel as possible.

"Prof. E. D. Cope, of Philadelphia, the eminent vertebrate paleontologist, had volunteered to accompany me on the expedition and assist in making collections. His offer was gladly accepted, and he was with me part of the summer, and rendered invaluable service.

* * * * * * *

"We traveled northward along the eastern escarpment of the Staked Plains as far as the town of Dickens, in Dickens county, a distance of about 150 miles; thence up Blanco Canyon to Mount Blanco; thence east across the higher plateau, and reached the eastern edge of the Staked Plains at Dutchman creek; thence northward along the base of the Plains to Clarendon; thence west to Goodnight and the mouth of Mulberry Canyon, and south to the mouth of Palo Duro Canyon; thence up the south side of the canyon to its head, twelve miles south of Amarillo. From Amarillo we went south to the head of Tule Canyon, in Swisher county, a distance of about seventy-five miles; thence down the north side of that canyon to its confluence with Palo Duro Canyon, and thence to Clarendon. This completed the exploration of the Tertiary and Triassic. From Clarendon we traveled southeast to Quanah, a distance of 100 miles; thence, turning southwest, crossed Pease river at the mouth of Catfish creek; thence south to the head of Good creek, and down that creek to its junction with the north prong of the Big Wichita river; thence, turning southeastward, down the divide between the Big Wichita and Beaver creek, went as far as the northeast corner of Baylor county; thence south, near the east line of Baylor county, to the Brazos river. Crossing the Brazos, we turned southwestward up Miller's creek to its source, and thence west back to the Brazos, recrossing it a few miles east of Kiowa Peak, in the northeast corner of Stonewall county, and thence to the Salt Fork of the Brazos, and up that stream to the mouth of Salt Croton creek, and up that creek to the Falls.

"From this point we traveled north to the town of Guthrie, the county seat of King county, situated on the south prong of the Big Wichita river; thence turned eastward through the towns of Benjamin, Seymour, Archer, and Henrietta, to the eastern edge of the Upper Cross Timbers; thence turning southward, we passed through Bowie, Decatur, and Lewisville to Arlington, in the eastern edge of Tarrant county, where I disbanded my party and sent my camping outfit into winter quarters near Austin, having been in the field six months." Pp. 179-180.

82. ———

A Question of Priority.

Amer. Geologist, Vol. XV, pp. 395-396. Minneapolis, June, 1895.

CUMMINS, W. F.

Mr. Cummins here offers a vigorous protest against the substitution of "Palo Duro" for his term "Goodnight," which appears in a paper on "The later Lacustrine Formations of the West," read by Professor W. B. Scott, an abstract of which appears in the Bulletin of the Geological Society of America, Vol. V, p. 94 (1894), and in several places in the Fourth Edition of Dana's Manual of Geology. Mr. Cummins contends that inasmuch as he both discovered and described the beds, which occur five miles southwest of the town of Goodnight, in Armstrong county, Texas, and collected the fossils described by Professor Cope, and inasmuch as the beds do not occur in or near Pala Duro Cañon, that his name of "Goodnight Beds" should stand by right of priority, and that it would be a misnomer to call them "Palo Duro."

See Scott, W. B., "A Question of Priority," No. 348.

83. CURTICE, COOPER.

Discussion of R. T. Hill's paper on "The Comanche Series of the Texas-Arkansas Region."

Bulletin Geol. Soc. of America, Vol. II, pp. 527-528. 1891.

"To what has already been said in regard to the erosion of the escarpment surrounding the central basin of Texas, I wish to contribute the following remarks:

"In going from Burnet, Texas, situated on the edge of the escarpment, southward to Marble Falls, on the Colorado river, one successively crosses the following strata: lower Cretaceous, Burnet Marble series (either Carboniferous or Silurian), Potsdam, Capitol granites, and Carboniferous. The Burnet Marble appears to abut against the Potsdam sandstone. The sandstones rest horizontally upon the granites, and their lower beds are made of small masses of feldspar and quartz entirely like that of the granite. The summits of the sandstone beds rise over a hundred feet higher than the Carboniferous at Shinbone ridge, which they approach to within a couple of miles.

"The semi-crystalline limestones of Shinbone ridge abut against the granites, but dip away from them. Carboniferous fossils were found within a very short distance from the contact in an abandoned prospect hole. These limestones were on a level with the granites, or about on a level with the base of the Potsdam sandstone.

"On the road westward from Burnet to Bluffton the following exposures were observed: Near Spring creek, a contact of the Burnet marble with Potsdam (*Lingula*-bearing) sandstones, with the Potsdam lying on granites; between Spring creek and Clear creek, apparently stratified granites; at Clear creek, upturned Packsaddle schists, with inclosures of the granites. The granites underlying the Potsdam and intrusive into the Packsaddle schists were apparently of the same mass.

"Potato hill lies about a mile north of the Clear creek crossing and two miles west of the escarpment. It is entirely composed of Potsdam sandstone, and its top is on a level with the crest of the adjacent escarpment. Its strata dip gently toward the northwest. *Conocephalites tripunctatus* (or *roemeri*), a fossil peculiar to the middle of the Potsdam series, occurs in its topmost bed. At the foot of the escarpment, a little north of east

CURTICE, COOPER.

of Potato hill, Potsdam shales lie in contact with Burnet marbles. Towards the top of the escarpment fossils said by Professor Hill to be from the horizon of the Trinity sands, the base of the 4,000 feet of Cretaceous strata, are quite plentiful. These are about on the level of the Potsdam fossils not two miles away.

"The contact of the Carboniferous with granites, which are overlain by horizontal sandstones, and of the Potsdam sandstones and shales with Burnet marbles at three different localities, suggest the presence of a system of faults—vertical displacements—which must be taken into account while considering the level of the central area when the Cretaceous was deposited.

"The injection of granitic material into the Packsaddle schists; the clean, fault-like contact of the 'Shinbone' Carboniferous with the granites; and the apparent formation of the lower beds of the nearly horizontal strata of the Potsdam from the decomposed constituents of the underlying granites, all point out the post-Packsaddle and Pre-Potsdam age of the latter."

83a. DALL, WILLIAM HEALEY.

Contributions to the Tertiary Fauna of Florida with especial reference to the Miocene Silex-Beds of Tampa and the Pliocene Beds of the Caloosahatchie River.

Transactions of the Wagner Free Institute of Science of Phila., Vol. 3. August, 1890.

This work contains several references to Texas localities, or in the case of living forms to the coast of Texas; as on p. 17, *Bulla striata*, Brug. "This well-known species is found living as far north as Charlotte Harbor on the west and as Jupiter Inlet on the east coast of Florida; also on the coast of Texas, etc." On p. 25, *Terebra* (*Acus*) *protexta*, Conrad. "Recent on the coast of the United States from Cape Hatteras south to Florida and west to Texas, in two to fifty fathoms weedy bottom." On p. 36, *Drillia leucocyma*, Dall. "Recent, shores of the Gulf of Mexico from Florida to Yucatan, in three to five fathoms." On p. 71, Genus *Rostellites* Conrad, 1855. "Type *R. texana* Conrad, Eagle Pass, Texas." On p. 84, *Volutilithes precursor* Dall. Description of species. Figured on Pl. 6, fig. 1. "The specimens are of Eocene age, the locality half a mile east from Wheelock, Texas." On p. 102, *Fasicolaria distans* Lamask. "Recent on the coast of the United States from North Carolina to Florida and Texas." On p. 149, *Muricidae multangula* Philippi, "living on the eastern coast of North America from Cape Fear to Yucatan, together with the Antilles." On p. 155, *Cymia Woodii* Dall. "Miocene of New Jersey, in the Shiloh marls; Texas (Meek) and of Santo Domingo (Gabb)." On p. 158, *Scala Sayana* Dall. "Recent from Texas to Key West, and northward to Virginia."

84. DANA, JAMES D.

Manual of Geology treating of the Principles of the Science with special Reference to American Geological History. Fourth Edition.

New York, Cincinnati, Chicago: American Book Company. 1895.

DANA, JAMES D.

Texas: Mean Height of, p. 23; Archaean in, pp. 444, 446, 447; Cambrian, pp. 464, 466, 469, 477, 484; Upper Silurian, p. 537; Devonian, pp. 575, 580; Sub-Carboniferous, p. 637; Carboniferous, pp. 648, 690, 693; Permian, pp. 660, 685, 687, 688; Triassic, pp. 660, 746; Cretaceous pp. 817, 824, 854; Disturbances in, p. 868; Tertiary, pp. 884, 885, 888; Quarternary, p. 378.

85. (DAY, DAVID T.)

Art. Gold and Silver. Min. Resources of the U. S. 1888. (Silver Production in Texas, 1887, 1888), p. 37. Washington, 1890.

From a table showing the "Approximate distribution in round numbers of the estimated total products of precial metals in the United States during the calendar years 1881 to 1888, inclusive," the following statistics are taken:

STATE.	1887.	1888.
Texas	$250,000.	$300,000.

86. (——————)

Art. Lithographic Stone. Min. Resources of the U. S. 1889-1890. (Lithographic Stone in Texas), p. 519. Washington, 1892.

Property of the Texas Lithographic Stone Company in Blanco county. Mr. John A. Roper, of Marble Falls, resident superintendent, reports that the company has placed machinery on the ground for quarrying, sawing and dressing stone.

87. (——————)

Art. Gold and Silver. Min. Resources of the U. S. for 1895, Part III, Seventeenth Ann. Rept. U. S. Geological Survey. (Silver in Texas), p. 72. Washington, 1896.

In a table here published, entitled "Approximate distribution, by producing States and Territories, of the product of gold and silver in the United States for the calendar year 1895, as estimated by the Director of the Mint," Texas is credited with the production of 450,000 fine ounces of silver, having a coining value of $581,810.

88. DAY, WILLIAM C.

Art. Structural Materials. Min. Resources of the U. S. 1886. (Building Materials in Texas), p. 530. Washington, 1887.

In Austin, stone in combination with brick is used in the finest buildings. The stone most used is a magnesian limestone, locally quarried. Granite from Burnet is used to some extent. Bricks yellow. In Galveston one house was erected in 1886 from a close grained sandstone quarried in Brown county. The trimmings were of granite from Burnet.

89. DAY, WILLIAM C.

Art. Structural Materials. Min. Resources of the U. S. 1886. (Kaolin in Texas), p. 573. Washington, 1887.

"At Leaky, Edwards county, Texas, a company was formed for the development of Kaolin deposits in that region."

90. ————————

Art. Structural Materials. Min. Resources of the U. S. 1887. (Building Material in Texas), p. 511. Washington, 1888.

Brick used in San Antonio. Brick clay found 12 miles northwest of the city. Cement manufactured near the city.

"An excellent quality of cement is manufactured near the city (San Antonio) by the Alamo Cement Company. It has been used in a number of public buildings, including the State Capitol at Austin."

91. ————————

Art. Structural Materials. Min. Resources of the U. S. 1887. (Lime in Texas), p. 533. Washington, 1888.

State, Texas; Locality, Austin; Production, barrels of 200 pounds, 80,000. The production is said to be 25 per cent. above that of 1886.

92. ————————

Art. Structural Materials. Min. Resources of the U. S. 1888. (Building Material in Texas), pp. 533-534. Washington, 1890.

In Austin magnesian limestone used for foundations. This and Burnet granite used in superstructure. Common brick straw yellow. Good lime locally manufactured.

In Dallas no good rock for foundation purposes; brick mostly used. Red sandstone from Colorado and granite from Burnet used in superstructures.

In Galveston foundations made of concrete; also of granite blocks. Granite from Burnet, magnesian limestones from various places and brown sandstone from Brown and Leon counties used for ornamental purposes. Common bricks red and gray. Clay thought to be of good quality, but manufacture defective.

93. ————————

Art. Structural Material. Min. Resources of the U. S. 1888. (Condition of the Brick Industry in Texas in 1888), p. 563. Washington, 1890.

From a table showing the "Condition of the brick industry in 1888," the following statistics are taken:

Day, William C.

State.	Towns.	Number of bricks made in 1888.	Remarks.
Texas.	Dallas.	20,000,000	Two new yards were established during 1888, with an aggregate capacity of 2,000,000.
	Laredo.	12,000,000	
	Paris.	4,000,000	
	San Antonio.	4,500,000	
	Texarkana.	2,500,000	
	Waco.	8,000,000	

94. ————

Art. Structural Materials. Min. Resources of the U. S. 1888. (Condition of the fire-brick industry in Texas in 1888), p. 566. Washington, 1890.

State.	Towns.	Number of fire-brick made in 1888.
Texas.	Athens.	200,000
	San Antonio.	12,000,000

95. ————

The Granite Industry of the United States.

(Statistics of the Production and Consumption of Granite in Texas in 1889.)

Engineering and Mining Journal, N. Y., Vol. LI, p. 496. April 25, 1891.

Number of Quarries 8; Product 20,400 cu. ft. valued at $22,550; Value per cu. ft. $1.11; Total number employed 64; Expenses: Wages $20,464; Total $33,738; Capital invested: In Land $184,000. Total $212,125.

96. ————

Art. Stone. Min. Resources of the U. S. 1889-1890. (Stone in Texas), pp. 431-432. Washington, 1892.

Granite: "Eight quarries in Burnet, Gillespie and Llano counties, all in the central part of the State, produced granite valued at $22,550." Used mainly for building purposes. Granite unexhaustible near Marble Falls. Color ranges from red or rose to light gray with intermediate shades. "It has shown a resistance to a pressure of 11,891 pounds to the square inch before crushing." It is used in the construction of the large dam across the Colorado river at Austin. Marble and sandstone are found in the same region.

Sandstone: "The value of the sandstone produced in 1889 in Texas was $14,651. It was taken from seven quarries, contained in the following

Day, William C.

counties named in order of relative outputs: Washington, Parker, Grimes, Llano, Brown, Collin and Wise. It was entirely used for building."

Limestone: "Limestone, valued at $217,835, including the value of lime made from a portion of it, was obtained from eighteen quarries, contained in the following counties, named in the order of their importance: Travis, $62,686; Hood, $50,000; Bell, $35,698; Grayson, $23,040; El Paso, $19,138; and smaller amounts from Washington, Lamar, Fannin, Lampasas, Coryell and Dallas. The product to the value of $135,901 was used for building. The value of the lime produced was $6,700. The remainder was used for flux, street and bridge work."

97. ————

Art. Stone. Min. Resources of the U. S. 1891. (Sandstone in Texas), p. 463. Washington, 1893.

Texas: Value of sandstone product for 1891 was $6,000.

98. ————

Art. Stone. Min. Resources of the U. S. 1891. (Limestone in Texas), p. 467. Washington, 1893.

Texas: Value of limestone output in 1891 was $175,000. Used for building purposes.

99. ————

Art. Stone. Min. Resources of the U. S. 1892. (Granite in Texas), p. 706, also p. 708. Washington, 1893.

Texas: Value of granite product in 1892, $50,000.

100. ————

Art. Stone. Min. Resources of the U. S. 1893. (Granite in Texas), pp. 544 and 547. Washington, 1894.

Texas: Production of granite in 1893 was valued at $38,991.

101. ————

Art. Stone. Min. Resources of the U. S. 1893. (Sandstone in Texas), p. 553. Washington, 1894.

Texas: Production of sandstone in 1893 was valued at $77,675.

102. ————

Art. Stone. Min. Resources of the United States. 1893. (Limestone in Texas), p. 556. Washington, 1894.

Texas: Product of limestone in 1893 was valued at $28,100.

103. ————

Art. Stone. Min. Resources of the U. S. 1894. Non-metallic Products.

Sixteenth Ann. Report U. S. Geological Survey, Part IV. (Sandstone Industry in Texas), p. 492. Washington, 1895.

DAY, WILLIAM C.

"The value of the output [1894] was $62,350, which is quite an increase over the product of a few years ago. The output comes from quarries in Washington, Parker, Grimes, Llano, Brown, Collin, and Wise counties."

104. ———————

Art. Stone. Min. Resources of the U. S., 1894.
Non-metallic Products.
Sixteenth Annual Rept. U. S. Geological Survey, Part IV.
(Limestone in Texas), pp. 509-510. Washington, 1895.

"There appears to have been quite a falling off in the limestone industry in Texas. The total value of the output was only $41,526. Most of this went for building and road making. The productive counties are Coryell, El Paso, Bell, Williamson, Travis, Hood, Grayson, Hamilton, Lampasas, and Mills."

105. ———————

Art. Stone. Min. Resources of the U. S. 1895.
Non-metallic Products, except Coal.
Seventeenth Annual Report of the United States Geological Survey, Part III (continued).
(Sandstone in Texas), p. 780. Washington, 1896.

"Owing to increased operations of a few important concerns, the output of sandstone in Texas increased from a valuation of $62,350 in 1894 to $97,336 in 1895. This is the highest figure yet reached for sandstone in the State."

106. ———————

Art. Stone. Min. Resources of the U. S. 1895.
Non-metallic Products, except Coal.
Seventeenth Annual Report U. S. Geological Survey, Part III (continued).
(Limestone in Texas), p. 795. Washington, 1896.

"The value of the limestone product in 1895 was $62,526. The output was greater than that of 1894."

107. DE RYEE, WILLIAM.

Economic Geology of Webb County.
Geological and Scientific Bulletin, Vol. I, No. 5. Houston, Sept., 1888.

"Laredo, the county seat of Webb county, is geologically situated upon the Eocene or lower deposits of the Tertiary Epoch, which rest upon a depression of the Cretaceous formation.

"The lithological characteristics of the marine, fluvio-marine and lacustrine deposits of the Eocene formation are better represented in Webb, Encinal and adjoining counties than in either the London or Paris basin;

DE RYEE, WILLIAM.

the strata lay nearly as they have been deposited, and their dip is generally insignificant."

Compact limestone; shell limestone; siliceous limestone; abundance of raw materials adapted to the production of cement, concrete and artificial stone; Ornamental and building sands; Clays.

"The mines in Webb county, 25 miles from Laredo, and connected with it by standard and narrow gauge railroad tracks, turn out monthly about 2000 tons of good coal. The best coals of these mines are similar in appearance and quality to cannel coal. They are superior to the lignites and bituminous shales found heretofore in geological strata of the same age."

108. DILLER, J. S.

Administrative Report.

Ninth Ann. Rept. of the U. S. Geological Surv. 1889. (Chalk in Texas), p. 98.

An announcement of Professor Hill's recent description of Chalk formations in Texas, which a microscopic examination shows to be "made up of the remains of foraminiferal organisms, and therefore true chalk."

109. DRAKE, N. F.

Stratigraphy of the Triassic Formation of Northwest Texas.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 225-247. Austin, 1892.

Contents: Introductory. Topographical Features. Lithological Characteristics: Sandstones; Conglomerates; Clays. Thickness and Unconformability. Stratigraphy: The Lower Bed; the Central Beds; Upper Beds; Dip of the Formation; Springs; Deposition; Local Development.

"The Triassic formation was examined in the vicinity of Dockum, Dickens county, by Professor W. F. Cummins, in 1889, and by him described, under the name of Dockum beds, in the First Annual Report of the Texas Geological Survey. In the Second Annual Report of the Survey, he gave a more extended description of these beds, and stated the published conclusions of other geologists concerning the formation in Texas, drawn from previous observations.

"I first saw this formation at Dockum, in company with Professor Cummins, in 1889, being attached to his party as assistant; but nearly all of the present report is the result of observations made by myself in Texas and New Mexico during the past field season.

"The Dockum beds underlie all, or nearly all, of the Staked Plains of Texas and southeastern New Mexico, extend further back into New Mexico northwest of the Plains, and have some extension under the Cretaceous area south of them in Texas.

"The limit of the Plains on the east, north and west is marked by an escarpment which is usually from one to two hundred, and sometimes three or four hundred feet high. The basal portion, sometimes nearly all of this escarpment, is composed of the Triassic beds. These beds usually

DRAKE, N. F.

extend six or seven miles from the base of the escarpment and nearly surround the plains by a narrow band, as is shown on the map. * * *

"As is there shown, this belt extends through Iatan, Mitchell county; Gail, Borden county; Dockum and Espuela, Dickens county; Goodnight, Armstrong county; three miles north of Amarillo, Potter county; center of Oldham county; Liberty, New Mexico, and, with some breaks, down the east side of the Pecos river to Castle Mountains, Crane county. The formation spreads out to a considerable width in the vicinity of Liberty, New Mexico, and west of the Pecos river opposite Fort Sumner.

"The nearly horizontal strata of sandstone, conglomerate and clay, varying in thickness and resistance to erosion, have been carved into by branches, ravines and creeks, leaving a rolling landscape. The regular undulating nature of the beds is occasionally interrupted by more or less precipitous outcrops of sandstone or conglomerate strata. These rocks, resisting erosion longer than the others, often remain capping some point or ridge, walling in the narrow valley of some creek, or forming the channel wall of some ravine or branch. These sandstones or conglomerates are, however, rather soft, and their outcrops are not usually conspicuous away from the rapidly carving action of the streams, but give a rolling character to the surface by slightly holding in check the wear of points here and there, while the intervening softer rocks are worn deeper and deeper.

"The topography of the Triassic beds is undoubtedly affected to some extent by irregularities in the erosion of the overlying Tertiary beds. This erosion first marking the places that are afterwards worn down into drainage courses or left as dividing ridges.

"Going back from the foot of the Plains to where the Dockum beds disappear, the rolling nature of the country grows somewhat less, and in some places is quite level.

"Sandstones, conglomerates, and clays constitute nearly all the strata of this formation.

"The materials composing the different strata vary somewhat in lithological characteristics at different localities, and even at the same locality, but the general characteristics are quite uniform, and are so different from the underlying Permian and overlying Cretaceous or Tertiary, that they are usually easily recognized. This is especially true of the sandstones and conglomerates." Pp. 227-228.

110. ——————

Report on the Colorado Coal Field of Texas.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 355-446; 1 cut; 2 plates; 2 maps. Austin, 1893.

Contents: Introduction: Hydrography; Topography; Relations and Extent of Formations; Acknowledgments. General Geology: Cretaceous; Trinity Conglomerate, Trinity Sands, Alternating, Paluxy, and Texana Beds, Comanche Peak Limestone, Caprina Limestone. Carboniferous: Origin of the Sediment of the Strawn and Overlying Divisions; Strawn Division; Canyon Division; Cisco Division; Albany Division. Economic Geology: Coal; Chaffin Seam, Upper or Bull Creek Seam, The Chaffin Coal, Bull Creek Coal Seam. Oil and Gas; Origin of Oil and Condi-

DRAKE, N. F.

tions of Accumulation. Iron Ore. Clays. Building Stone: Weathering and Durability of Building Stones; Building Stones of the Carboniferous Beds; Strawn Division; Canyon Division; Cisco Divison; Albany Division; Cretaceous Building Stones. Road-making Material. Paving Material. Grind Stones; Lime Manufacture.

"The region embraced in the following report lies between 31° 10′ and 32° north latitude and 98° 30′ and 100° west longitude. This area, about 4000 square miles, includes nearly all of Brown and Coleman counties, Runnels county east of Norwood, the northeast part of Concho county or the part lying east of Paint Rock and north of Eden, McCulloch and San Saba counties north of Brady creek and the town of San Saba, the northwest corner of Lampasas county, Mills county west of the Gulf, Colorado and Santa Fe Railway, and a small area in Comanche county north and northwest of Comanche.

"Preliminary examinations of the Carboniferous beds of this area have been made by Messrs. W. F. Cummins and R. S. Tarr, and like investigations of the Cretaceous areas have been made by Messrs. R. T. Hill and J. A. Taff.

"These geologists have determined the stratigraphic relations of the divisions and terranes of these formations, and their classifications have, for the most part, been followed in this report. The work of the present season has been of a more detailed character than that hitherto undertaken. Each bed has been studied with reference to its extent, stratigraphic relations, lithologic characters, fossil forms, and economic features.

"The whole of this region, except that portion embraced in Comanche county, is drained by the Colorado river and some of its tributaries. While it is practically all in the same hydrographic basin, it has branching basins, which are of considerable extent, and are more or less distinct within themselves. So we may consider this area under its main and two other principal branching basins. These three basins are as follows: In the south we have the lower part of the San Saba river basin drained by the lower course of that river, with Brady creek and other smaller streams emptying into it from the north; the central portion comprises a part of the Colorado river basin, drained by the Colorado river and its numerous small tributaries from either side, together with a little of the lower course of the Concho river; and the northeastern part is drained by Pecan bayou, with its tributary creeks, Wild Horse, Willis, and Jim Ned from the west, and Eliott, Brown, Bull, Elm, Hog, Paint, and other creeks from the east and north.

"The general slope of the country is to the southeast, but this slope is modified to form the above named basins. The San Saba river and Brady creek basin slopes to the east, the main Colorado river basin to the southeast, and the Pecan bayou basin to the south. These three basins converge towards a common point near the northeast corner of San Saba county.

"There are two principal or general phases of the topography, one characteristic of the Cretaceous, and the other of the Carboniferous. The Cretaceous formation, lying nearly horizontal and composed of beds of increasing hardness from the base upwards, with some horizons that slightly alternate in hardness, presents bluff, bench, or terraced undulations along

DRAKE, N. F.

the edges of these outcropping beds, and has flat tops of greater or less extent, according to the amount of the capping material of the harder horizons.

"The Carboniferous, composed of beds dipping to the west and northwest, has a topography characterized by parallel ridge-like undulations which extend northeast and southwest, or more exactly N. 20° to 30° E., and S. 20° to 30° W. These ridges slope so gently on the west side that they may be more properly called escarpments or benches. The bench or the escarpment faces east, while the slope of the surface to the west and northwest is slightly less than the dip of the underlying strata, and in the same direction. The lowest level reached on the northwest side of these ridges or benches does not quite extend down to that on the southeast side, so that going northwest, each ridge or escarpment gone over places one at a slightly higher elevation than the preceding one, thus making the average slope of the country to the east and southeast, while most of the surface slope is to the northwest. This character of topography exists because of the dip of the beds N. 60° to 70° W., and because of the different degrees of hardness of the beds. The softer beds rapidly erode and are carried away, leaving the harder beds projecting at the top of the escarpments, and forming the surface rock to the west and northwest, nearly to the base of the next escarpment of overlying beds.

"The whole of this area was once covered by Cretaceous strata, which rested unconformably on Carboniferous, the former dipping very slightly to the southeast and the latter dipping 25 to 300 feet per mile to the northwest. Most of this Cretaceous cap has been carried away by erosion, leaving the underlying Carboniferous beds exposed.

"Unequal erosion over this area has left the Cretaceous with an irregular border, and in isolated areas; or the Cretaceous areas in this field are now as follows: In isolated buttes, such as Santa Anna Mountain, Bead Mountain, Robinson Peak, etc., in areas of considerable extent, as that south of Brownwood and that north of Talpa; and others in ridges or spurs, like the Brady mountains, running out from the main Cretaceous area.

"The Carboniferous beds of this field comprise the southern extension of the central Carboniferous area, which extends from a little south of the Colorado river in San Saba county northward nearly to the Red river in Montague county. This Colorado river coal field is almost cut off from the main body of the Coal Measures to the north by the overlying necklike extension of the Lower Cretaceous beds stretching from the west corner of Comanche county across the southwest corner of Eastland and the southern part of Callahan, into Runnels county." Pp. 357-359.

111. DUMBLE, EDWIN T.

The Nacogdoches Oil Field.

Geol. and Scientific Bull., Vol. I. Houston, July, 1888.

"The existence of oil in these eastern counties has been an acknowledged fact for many years, and numerous attempts have been made to obtain it in paying quantities, none of which proved at all successful until lately. About two years ago several parties concluded that they would investigate

DUMBLE, EDWIN T.

the matter thoroughly, and, going through the country, took mining leases on such lands as they thought most promising. The best indications were found about fourteen miles southeast of Nacogdoches, where they occur at different places, and are abundant over a tract of land seven miles square, lying adjacent to Oil City, the name of the new town.

"The first boring was done in the spring of 1887, and the first well was a success, securing a good flow of oil at 70 feet. At once the country was wild with excitement, mining leases were made on all available property, and those taking them were compelled at length to insert an agreement to begin work within sixty days. Companies were formed and machinery was ordered, and then, like all flurries, the reaction set in. The second well did not prove as good as the first, the next showed still less oil, and some of the others none at all. * * * Those who were doing the boring, however, were used to the vicissitudes of oil prospecting, and were in no wise discouraged by a few dry wells, especially as the oil found proved to be of a very superior quality. Thirteen wells have been bored, some of them giving a mere seepage of oil, others from one to forty barrels per day.

* * * * * * *

"As stated above, the quality of the oil is very superior. Actual test is the strongest proof, and a letter from the management of one of the largest railroads in the Northwest states that during last February this oil was exposed in the open air for twenty-four hours and then tested. The temperature of the air was 19° below zero, and that of the oil 18° below, and at that temperature it flowed freely, thus proving conclusively its value as a lubricant for all portions of the country liable to extremely low temperatures.

"The specific gravity of this oil is about 28° Beaume, while the ordinary oils of Pennsylvania are 43° to 48°, and the West Virginia lubricating oils 30° to 37°.

"The geological horizon of this oil is the Claiborne sands of the Lower Eocene, the strata passed through being beds of sandy clay and a blue clay with shells, which we have had examined with a view to determining their exact geological age. The oil is found in a very porous rock immediately underlying this shell, marl and clay.

* * * * * * *

"Prof. Everhart, of the State University at Austin, had a sample of the oil sent him for analysis during last summer, and we await his report with a great deal of interest. [See Everhart, Edgar, Contributions from the Chemical Laboratory, University of Texas, Bulletin No. 4.]

"The actual shipments of this oil amount to something over fourteen hundred barrels to May 1st, 1888."

112. ———————

Notes on the Iron Ore Deposits of Eastern Texas.

Geological and Scientific Bulletin, Vol. I, No. 5. Houston, Sept., 1888.

"The iron ores of the Tertiary formation, which occur so abundantly in Eastern Texas, have received more or less attention for many years. A

DUMBLE, EDWIN T.

good description was first given of them by Dr. Shumard, while he was State Geologist, and it is a matter to be deeply regretted that the valuable maps of the counties he examined in this region, and the description of their geological formations, as he had determined them, have been lost to the State. At a later date, Dr. Buckley made a reconnaissance through this section, and visited and described some of the better known localities, where furnaces had been erected or where heavy deposits were supposed to exist.

"The practical value of these ores as iron producers has been fully demonstrated by the numerous furnaces which have been erected and run on them. * * *

* * * * * * *

"The geological position of these deposits is immediately above the blue and yellow marls of the Claiborne group of the Eocene Tertiary, from which they are separated by a stratum of red and peculiarly mottled clay, which has a very wide development. I have observed it from Shelby county, on the east, down the line of the H. E. & W. T. Railway into Polk county, and as far west as Goliad, and from Cherokee to Jasper county. As a rule, the ore beds, which are nearly horizontal, occur only at or near the tops of the knobs or hills, and have for covering nothing more than a bed of gray or light colored sand, and frequently even this is absent. These beds are therefore not continuous, but lie in detached masses, and it often happens that the talus from the seam above so covers the hillside as to make it appear a mountain of iron ore. The thickness of these beds is variable, being from one inch to five feet, and even greater in places. The capping is generally a silicious iron, which is often present even when the ore is not. To the south and west, as in Jasper and Bastrop counties, this seems to pass into an iron sandstone, sometimes of considerable thickness.

"The overlying sands are compacted in some places, as may be seen along the line of the H. E. & W. T. Railway, at various localities between Lufkin and Timpson, and their peculiar formation shows the work of wind and tide.

"The ores themselves consist of hematites, limonites and argillaceous varieties, and occur massive, honey-combed and laminated, or of concretionary structure, the former predominating in the eastern and the latter in the western part of the district. Thus the 'laminated' and 'brown crumbly' are the varieties used at the furnaces at Rusk and Kelleyville, while in Robertson county concretionary forms and argillaceous ores are very abundant, and may be seen at the lignite bluff on the Brazos river. Pot ore and pipe ore are also of frequent occurrence.

"In Sabine county specimens were brought me that were as rich in appearance as some of our Llano ores, but my limited time prevented an examination of the localities from which they were obtained.

"Analyses of these ores, made by Prof. Everhart and others, show that they contain from thirty-five to sixty-one per cent. of metallic iron, and are very low in phosphorus. The iron from these ores is unexcelled for many grades of castings, such as car wheels, agricultural implements, etc., on account of its chilling properties, but for softer castings other ores must

DUMBLE, EDWIN T.

be selected to mix with them. It is possible that ores of the desired quality may be found among these deposits, or it may be necessary to use some of the Llano ores for this purpose.

"Numerous detached islands of the Cretaceous formation, scattered through this region, furnish limestone sufficient for smelting purposes, while for fuel there are immense forests of pine, oak, etc., which cover the eastern part of the State, and the deposits of lignite which underlie the entire territory, and which will undoubtedly be made use of as soon as the erection of iron furnaces and the reduction of ores begin in earnest.

"From Sabine to Cass county on the east, and extending west to Bastrop county, these deposits are found, scattered over thousands of square miles of territory; and while they are not found in all the counties within these boundaries, and sometimes when found are of too impure quality, or in too small quantity, to be of economic value, yet it is a fact fully demonstrated by the examinations already made that in these deposits we have an almost limitless supply of ore for many years."

* * * * * * *

113. ——————

Geological Survey of Texas, Circular No. 3. Nov. 1, 1888. (Official.)

Geological and Scientific Bulletin, Vol. I, No. 7. Houston, November, 1888.

This circular, accompanied by a map, was addressed to the more intelligent citizens of the different counties of the State for the purpose (1) of obtaining information concerning the economic minerals known or thought to occur in Texas, (2) of correcting existing maps, and (3) of securing personal observations on the local geology, soil, irrigation, quarries, etc.

The following list of economic minerals in Texas is appended: 1, Asphaltum; 2, Arsenic; 3, Asbestos; 4, Barytes; 5, Bat Guano; 6, Copper; 7, Coal (including Lignite); 8, Strontian Sulphate; 9, Chalk; 10, Diatomaceous Earth (Tripoli); 11, Feldspar; 12, Flint; 13, Fluor Spar; 14, Fire Clays; 15, Gold; 16, Millstone Grit; 17, Whetstone Material; 18, Graphite; 19, Gypsum; 20, Glass Sand; 21, Marls; 22, Iron; 23, Kaolin; 24, Lead; 25, Manganese Ore; 26, Mineral Waters; 27, Building Stones and Marble; 28, Cement Rock; 29, Limestone and Shells for Lime; 30, Lithographic Stone; 31, Ochres; 32, Mineral Paints; 33, Petroleum; 34, Natural Gas; 35, Pyrites; 36, Silver; 37, Salt; 38, Sulphur; 39, Soapstone; 40, Mica; 41, Alum Shales; 42, Saltpetre; 43, Brick Clays.

114. ——————

Texas Asphaltum.

Geological and Scientific Bulletin, Vol. I, No. 11. Houston, March, 1889.

Need of material in Texas suitable for pavements. Use of Trinidad asphalt mixed with calcareous matter in imitation of the Val-de-Travers deposit. Quotation from Dr. Ure on bitumen and calcareous earth.

DUMBLE, EDWIN T.

"Among the specimens collected by Col. J. L. Tait, on his trip to Southwest Texas last November, was a small piece of dark-blue limestone thoroughly impregnated with bitumen. The rains were so continuous, however, that no detailed examination could be made, but later advices inform us that the quantity is equal to all demands, and a somewhat larger specimen was obtained and subjected to analysis, with the result of proving it almost identical in composition with that of Val-de-Travers, as will be seen by the following:

"Val-de-Travers: Bitumen, 20 per cent.; limestone, 80 per cent. Uvalde county: Bitumen, 20.35 per cent.; limestone, 79.65 per cent.

"This, we think, will prove to be of great and lasting benefit to the State. In addition to this, many deposits of bituminous sands or shales occur, which yield ten per cent., and sometimes a larger amount, of bitumen."

115. ————————

Petrified Wood.

Geological and Scientific Bulletin, Vol. I, No. 12. Houston, April, 1889.

"Dr. Roemer, in 'Kreidebildüngen von Texas,' ascribes the origin of the silicified wood he observed in Texas to Tertiary time on two grounds. First, because it was found in large quantities at Booneville, near the Brazos river, in a sandstone which was immediately underlaid by undoubted Tertiary strata; and, second, because of its generic character, but states that nowhere was the presence of wood in Tertiary strata determined by direct observation.

"It was the good fortune of Dr. Penrose and myself, on our late trip down the Colorado, to prove the correctness of this opinion, and supply the missing evidence. Below Bastrop, in undoubted Eocene strata, we found petrified wood in place. It was of the usual grayish color. Further down the river, in the lignite beds, we had still stronger proof. Here we found many large logs imbedded in the lignite, and on careful examination we found that while the outer portion was in most instances converted into lignite, the centre, although equally black in color, was silicified. The interior portion corresponded exactly with specimens found some years ago in the drift in the vicinity of La Grange, the source of which is now readily apparent. As I have stated before in these columns, the specimens of petrified wood in Eastern Texas, which seemed to be in place, were usually in the red clay underlying the gravel."

116. ————————, State Geologist.

Texas Geological and Mineralogical Survey. First Report of Progress, 1888, 78 pp. Austin: State Printing Office, 1889.

Letter of Transmittal by L. L. Foster, Commissioner of Agriculture, Insurance, Statistics and History. Letter of Transmittal by E. T. Dumble, State Geologist. First Report of Progress by E. T. Dumble. Report of the Geologist for Western Texas by W. von Streeruwitz, C. E., M. E. (Table showing Rainfall at Fort Davis and Surrounding Circle of Coun-

DUMBLE, EDWIN T.

try of 100 miles Diameter. Average Annual Rainfall by Months. Normal Average Temperature in West Texas.) Report of Geologist for Northern Texas by W. F. Cummins. Report of Geologist for Eastern Texas by R. A. F. Penrose, Jr. Reports of Geologists for Southern Texas: (1) by Gustav Jermy, (2) by J. L. Tait, (3) by J. Owen. Economic Minerals of San Saba County, by A. Gregg, M. D.

117. ————

First Report of Progress.

Texas Geological and Mineralogical Survey. First Report of Progress, 1888, pp. 7-30; 9 cuts. 1889.

Appointments. Circulars 1 and 2 relating to the work of the Survey; Circular 3 requesting information and specimens. Office Work. Topographic Work. Meteorological Work. Chemical Work. Reports of Geologists. Mining Law. Irrigation. Responses to Circulars: Artesian Wells, Asphaltum, Building Stones, Bat Caves, Clays, Coal, Gypsum, Precious Metals, Iron, Irrigation, Mineral Waters, Natural Gas, Petroleum, Salt, Soils. Coal: The Central Coal Field—Bituminous, The Nueces Coal Field—Semi-Bituminous, The Lignite Field. Artesian Waters: Conditions of Artesian Wells, Essential Features of Artesian Wells, The Water-Bearing Beds, The Confining Beds, The Inclination of the Beds, The Reservoir or Fountain Head, The Collecting Area, Rainfall. Drouths. Conclusion.

118. ————

Art. Coal. Min. Resources of the U. S. 1888. (Coal in Texas), pp. 368-374. Washington, 1890.

"There are in Texas three distinct coal fields, the Central or Bituminous, the Nueces or Semi-Bituminous, and the Lignitic.

"The Central coal is a continuation of the Missourian or Western coal basin of the United States, of which it is the southern extremity. Its approximate boundary is a line from the eastern corner of Montague county, running southwest from Red river just west of Decatur and Weatherford, through Palo Pinto county, to the eastern line of Brown county, and from this point through Lampasas into Burnet county, where it terminates. It appears again in Kimble and Mason counties, and the line running north passes through Menard, Concho, Runnels, Taylor, Callahan, Shackelford, and Throckmorton counties, through the southeastern portions of Archer and Clay counties to the mouth of the Little Wichita. This field covers in whole or in part some twenty-five counties and has an area of not less than 12,000 square miles. Its eastern border is overlaid by the rocks of the Cretaceous formation, while the Permian beds rest upon it on the west. The section made by Professor Cummins shows the thickness of the formation to be not less than 2,000 feet, with nine seams of coal, of which two at least, and probably three, are workable." P. 368.

"The Nueces or Semi-Bituminous coal field includes parts of Webb, Dimmit, Zavala, and Maverick counties, and has an area of 3,700 square

DUMBLE, EDWIN T.

miles. The northern boundary has not yet been determined. It contains two workable seams of coal, and locally, at least three. These differ somewhat in character; the lower is a Semi-Bituminous coal, probably of Cretaceous age, which, so far as it has been examined, gives promise of being a very good fuel. It is being worked north of Eagle Pass at the Hertz mines. The other bed now being worked at San Tomas, is possibly of the Laramie group. It is somewhat lignitic, although quite different from the lignites of our Tertiary coal field. Another variety which is also found in some quantity in this coal field is albertite. This seam is northeast of the San Tomas exposure, and will prove valuable.

"The Lignite field is by far the largest, and the coal strata it contains are of much greater thickness than those of either of the others. As nearly as its boundaries can now be marked, they are as follows: Beginning on the Sabine river, in Sabine county, the boundary line runs west and southwest near Crockett, Navasota, Ledbetter, Weimar and on to Helena and the Rio Grande river; thence back by Pearsall, Elgin, Marlin, Richland, Salem, and Clarksville to Red river. It includes fifty-four counties in whole or in part, and while the occurrence of lignite has not been noted in every one of these, it will in all probability be found in all of them sooner or later. Four, possibly five, strata of lignite can be recognized in this field, one of which attains in many places a thickness of from 15 to 20 feet. The amount of sulphur contained in these lignites is very variable, as is indeed the quality of the lignite itself. In some places there is a good clean lignite, almost, if not entirely, free from sulphur, while at other places masses of sulphuret of iron are mingled through a carbonaceous mass." Pp. 368-369.

For outline of remainder of this report, see Ashburner, Charles A. (Coal in Texas), Min. Resources of U. S. for 1888.

119. ——————

Appendix to "A Preliminary Report on the Soils and Waters of the Upper Rio Grande and Pecos Valleys in Texas," by H. H. Harrington.

Geol. Surv. of Texas, Bulletin No. 2, pp. 24-26. 1890.

The effect of alkalies upon crops. The Experimental Farm above Pecos City irrigated by the waters of the Pecos river. Soils: Salt and other determinations by L. E. Magnenat. Rock material from which the soil is derived feldspathic. Apparent excess of alkalies not dangerous to agriculture.

"On page 10, Prof. Harrington makes this statement in regard to the effect of alkalies on the growth of crops: 'But so far as I can ascertain, the maximum quantity of alkali that any crop would tolerate and still thrive and do well has not yet been determined. The character of the soil would undoubtedly have great influence in this matter.' Such being the case, I have delayed the publication of this Bulletin that additional facts might be accumulated bearing upon this point, for it is one of the greatest importance to a large area in the Pecos Valley.

"Both before and since the commencement of this examination there has been an experimental farm in operation above Pecos City, using the waters

DUMBLE, EDWIN T.

of the Pecos River for irrigation. Upon it have been grown fruits, vegetables, grains and grasses, etc., and the yield has been of such a character, both in quality and amount, as to encourage the construction of canals and ditches and a considerable extension of the irrigation facilities. The claim made by the operators of the experimental farm is that the manner of irrigation prevents the accumulation of the salt to any hurtful extent. The plats are flooded with water and the porous nature of the soil permits rapid drainage. By this means, it is thought by them that the water, as it is applied, washes out the soluble salt left by former applications, and in turn leaves only about the same quantity as before, as it is drained away or evaporates.

"The facts, as I can learn them, are that up to the present, at least, no deleterious effects are noticeable from the application of the water. The crops continue to flourish, and there is no perceptible reason for expecting them to do otherwise while the water continues available as it is now.

"That there is, however, an iucrease in the amount of salt in the land after irrigation is fully proved by the following analyses made of virgin soil and exactly similar soil near it which had been irrigated for three years." P. 24.

120. ———————

First Annual Report of the Geological Survey of Texas, 1889. 8 vo., pp. xci, 410. Pl. x, and map. Austin, 1890.

Contents: Letter of Transmittal (L. L. Foster, Commissioner of Agri., Ins., Statistics and History, to Hon. L. S. Ross, Governor). Table of Contents. Table of Illustrations. Letter of Transmittal, E. T. Dumble, State Geologist, to Hon. L. L. Foster, Commissioner, etc. Report of the State Geologist, E. T. Dumble. Reports of the Geologists: W. von Streeruwitz, W. F. Cummins, R. T. Hill, Theo. B. Comstock.

Accompanying Papers: Preliminary Report on the Geology of the Gulf Tertiary of Texas, by R. A. F. Penrose, Jr. A Brief Description of the Cretaceous Rocks of Texas and their Economic Uses, by Robt. T. Hill. The Southern Border of the Central Coal Field, by W. F. Cummins. The Permian of Texas and its Overlying Beds, by W. F. Cummins. A Preliminary Report on the Coal Fields of the Colorado River, by Ralph S. Tarr. Geology of Trans-Pecos Texas—Preliminary Statement—by W. von Streeruwitz. A Preliminary Report on the Central Mineral Region of Texas, by Theo. B. Comstock.

This volume is noticed in the Amer. Naturalist, Vol. XXVI, Jan., 1892, p. 47.

121. ———————

Report of State Geologist.

First Annual Report of the Geological Survey of Texas, pp. xvii-lxxv. 1890.

Contents: Organization. Scope and Plan of the Survey. Plan of Operations. Work of the First Year: Topography, Geology, Laboratory,

DUMBLE, EDWIN T.

Museum, Library, Office. Results: Introduction, Topography, Geology. Gulf Coast Formations—Coast Clays, Fayette Beds, Timber Belt beds; Lignite, Laredo Coal. Basal Clays; Iron Ores. Cretaceous; Upper, Lower. The Central Basin Formations—Archaean, Eparchaean, Ores, Paleozoic—Cambrian, Silurian, Devonian, Carboniferous, Coal, Permian. Mesozoic—Jura-Trias. Artesian Water. Personnel. Acknowledgments.

122. ————————, and HILL, R. T.

See Hill, R. T., and Dumble, E. T.

The Igneous Rocks of Central Texas.

Proc. Amer. Assoc. for Adv. of Science, Vol. XXXVIII, pp. 242-243. 1890.

123. ————————

Report of Professor E. T. Dumble, State Geologist of Texas, on the Existence of Artesian Waters West of the Ninety-seventh Meridian, etc. (Submitted with the Report of Richard J. Hinton, Special Agent in Charge of the "Preliminary Investigation to determine the proper location of Artesian Wells within the Area of the Ninety-seventh Meridian and East of the Foot-hills of the Rocky Mountains.")

51st Congress, 1st Session, Senate Executive Document, No 222, pp. 99-102. Washington, 1890. (Accompanying this document there is a map of West Texas showing the location of Artesian wells.)

This paper is in reply to a request of the Special Agent "for a statement as to the existing artesian water conditions of that portion of Texas west of the ninety-seventh meridian and north of San Antonio," and is published under the direction of the Secretary of Agriculture.

"The part of the State covered by your request includes four topographic divisions. First, in its eastern part we find a small area of the Gulf coast formation followed by the plateau of Grand Prairie. From the northern and western scarp of this plateau the Central Basin region stretches away west to the Guadaloupe Mountains, beyond which we find the mountain region of Trans-Pecos Texas."

The small exposure of the Gulf Coast formation (Upper Cretaceous, Lower and Middle Tertiary) are too limited in area to need description.

Description of the Grand Prairie. "The western and northern edge of the Grand Prairie is, generally speaking, topographically higher than the eastern and the southern, and the dip of the beds is very gentle towards the southeast. The rock formation of this plateau belongs to the Lower Cretaceous series, and consists of a great thickness of limestones and chalks, magnesian, arenaceous and even argillaceous in places, which is underlaid by a bed of sands. * * *

"This bed, the Trinity or Upper Cross Timber Sands, is the base of the Lower Cretaceous System, and is the great water-bearing bed east and south of the central basin. * * *

DUMBLE, EDWIN T.

"In nearly every county between the ninety-seventh and ninety-eighth meridians and east of this outcrop, artesian water is obtained in wells varying from 200 to 2,000 feet. That it is equally favorable to a similar supply in its southern portion is shown by the line of great springs or natural artesian wells, which find their head in it and stretch from Williamson county southwest by Austin, San Marcos, and New Braunfels towards the Pecos."

The Central Basin Region: Its extent, topography and geology.

"The general dip of all the strata in the eastern portion of the basin is to the northwest, but its elevation along its eastern border is less than in almost any portion of it, consequently there can be little hope of finding artesian water from any catchment area on this side, although some of the strata (the lower sandstone and shales) are well adapted for carrying water, and, where suitable topographic conditions exist, do furnish artesian water. An instance of this is found in the flowing well at Gordon, but such cases are the exception and not the rule. The same series of sandstone and shales are exposed on the southeastern border and the flowing wells at and around Trickham and Waldrip find their supply in them. The conditions are very favorable in the valley of the Colorado and some distance north, between the ninety-ninth and one-hundredth meridians for similar wells. * * * Similar rocks are exposed on the western border of this basin, in the vicinity of Van Horn and farther north, in the Guadaloupe Mountains. They are reached by a well 832 feet deep, at Toyah, some 70 miles east of Van Horn. This well has an abundant flow. * * *

"The quality of the water from every well thus far secured in this basin, which has its origin in this series of rocks [Carboniferous] is highly saline, and it is safe to assume from this and from the character of the deposits that no fresh water can be obtained from this source. * * *

"If there be any other hope for an artesian water supply in this region, the catchment area must be either in the Pre-Carboniferous rocks of the Central Mineral Region and the Wichita Mountains, or in the Guadaloupe and connected ranges. That such a catchment area exists on the south is fully proved by the powerful springs at Lampasas and in San Saba county, all of which have their origin below the rocks of Carboniferous age."

The Staked Plains: Its geology and water-bearing conditions. The opinion is advanced "that the probabilities of artesian water on the plains are rather unfavorable than otherwise."

The Trans-Pecos Mountain District: Topography and geology. The conditions of structure prevent any other than a general unfavorable report, though in certain localities artesian water may be obtained.

124. ——————, State Geologist.

Important Results of the Texas Survey.

Correspondence.

Amer. Geologist, Vol. VII, pp. 267-269. Minneapolis, Apr., 1891.

DUMBLE, EDWIN T.

A summary of the work of the Texas Geological Survey for 1890. In East Texas iron deposits and accompanying Tertiary and Quaternary strata were mapped and studied. More than a thousand square miles of iron deposits in that area. Investigation shows the lignite of East Texas to be of better quality than that of Europe. Professor Cummins' discovery of Permian rocks. Triassic strata overlaid by conformable Tertiary along the eastern edge of the Staked Plains north of the Brazos. Dr. Comstock's work in Central Texas. Occurrence of cassiterite. Discovery of large amounts of minerals containing some of the rarer elements. Professor Streeruwitz's work in El Paso county, including Quitman, Sierra Blanca and other mountains. The Cretaceous of that region. The existence of free gold, gold and silver-bearing lead, copper and zinc ore regarded as fully demonstrated. The discovery of platinum in the Quitman mountains, El Paso county.

125 ————————, State Geologist.

Second Annual Report of the Geological Survey of Texas, 1890; 8 vo., pp. cix, 756; pl. xxviii. Austin: State Printing Office, 1891.

Letter of Transmittal (L. L. Foster, Commissioner of Agriculture, Insurance, Statistics and History, to Hon. J. S. Hogg, Governor). Financial Statement.

Contents: Report of State Geologist. Reports of Geologists: W. von Streeruwitz, Theo. B. Comstock, W. F. Cummins, J. B. Walker, W. Kennedy, J. H. Herndon. Accompanying Papers. Reports on the Iron Ore District of East Texas. Part I. General Statement by E. T. Dumble. Part. II. Fuels and their Utilization. Chapter I. Charcoal Manufacture in Texas, by John Birkinbine. Chapter II. Lignites and their Utilization, with special reference to the Texas Brown Coals, by Dr. Otto Lerch. Part III. Description of Counties. Chapter I. Cass County, by Wm. Kennedy. Chapter II. Marion County, by Wm. Kennedy. Chapter III. Harrison County, by Wm. Kennedy. Chapter IV. Gregg County, by Wm. Kennedy. Chapter V. Morris, Upshur, Wood, Van Zandt, and Henderson Counties, by Wm. Kennedy. Chapter VI. Smith County, by J. H. Herndon. Chapter VII. Panola County, by J. B. Walker. Chapter VIII. Shelby County, by J. B. Walker. Chapter IX. Rusk County, by J. B. Walker. Chapter X. Nacogdoches County, by J. B. Walker. Chapter XI. Cherokee County, by J. B. Walker. Chapter XII. Anderson County, by E. T. Dumble. Chapter XIII. Houston County, by E. T. Dumble. Carboniferous Cephalopods, by Alpheus Hyatt. Report on the Geology of Northwestern Texas, by W. F. Cummins. Report on the Geology and Mineral Resources of the Central Mineral Region of Texas, by Theo. B. Comstock. Report on the Geology and Mineral Resources of Trans-Pecos Texas, by W. H. von Streeruwitz.

For Review, see Amer. Naturalist, Vol. XXVI, p. 159, Feb., 1892.

Noticed in Amer. Jour. of Science, III, Vol. XLII, p. 430, Nov., 1891.

126. DUMBLE, EDWIN T.

Report of State Geologist.

Second Ann. Rept. Geol. Surv. of Texas, 1890, pp. xvii-lxxxviii. Austin, 1891.

Contents: Introductory. Work of the second year: Topography; Geology; Paleontology; Chemical Laboratory; Library; Museum; Office work; Publications; Co-operation with the Public Schools. Mineral Resources of Texas: Introductory; Fuels and Oils; Fertilizers; Fictile materials; Building material—Building stone; Clays for brick; Lime; Cement material; Plaster Paris; Sand for mortar. Metals and Ores—Iron; Copper; Lead and zinc; Gold and silver; Tin; Mercury; Manganese; Bismuth. Abrasives. Ornamental stones and gems. Refractory materials. Road materials. Materials for paints. Other economic materials. The Artesian water conditions of Texas. Acknowledgments.

127. ——————

Reports on the Iron Ore District of East Texas, Part I. A General Description of the Iron Ore District of East Texas.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 7-31. Austin, 1891.

Contents: Introduction. Historical. Topography. Stratigraphy. The Ores and their mode of occurrence.

"That part of Texas of which the following pages treat is situated in the northeastern corner of the State, being the territory lying east of the 96th degree of longitude and north of the 31st parallel of latitude. From this area we exclude, as being non-iron bearing, the portion north of Sulphur Fork, and also the northwestern corner, in which the black waxy prairies of the Cretaceous are the prevailing formation.

"In this district, so restricted, there are nineteen counties: Cass, Morris, Marion, Upshur, Wood, Harrison, Gregg, Panola, Smith, Van Zandt, Rusk, Cherokee, Henderson, Anderson, Houston, Nacogdoches, Shelby, Sabine and San Augustine, containing in the aggregate 14,430 square miles. In each of these counties iron ore exists in greater or less quantities and of varying qualities.

"Ores of similar character are reported from other counties west and southwest of this area, but our investigations have not extended further than the limits stated.

"As will be seen by reference to the accompanying map, the iron ores are very unevenly distributed through this region, and as we have mapped them cover an area of about 1000 square miles." P. 7.

128. ——————

Reports on the Iron Ore District of East Texas, Part III. Description of Counties. Chapter XII. Anderson County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 303-317. Austin, 1891.

Contents: Geography and Topography. Stratigraphy. The iron ores. Greensand marls. Salines.

DUMBLE, EDWIN T.

"Anderson county comprises the country lying between the Trinity and Neches rivers, bounded by Henderson county on the north and Houston county on the south, an area of one thousand and eighty-eight square miles." P. 303.

"The rock formations of Anderson county comprise representations of at least three systems: The Cretaceous, Tertiary and Quaternary. The details of the entire stratigraphy of each system have not yet been worked out, but the following broader characters have been determined:

System. (Period.)	Division.	Beds.
Quaternary		The sands and sandstones capping the iron ore hills.
Tertiary	Timber Belt Beds.	The iron ores. The greensands and accompanying beds of clays and sands.
Upper Cretaceous	Saline Limestone. Ponderosa Marls.	

P. 304.

"The deposits of iron ore in Anderson county, like those of the entire district, are found capping the highest hills, or in the case of some of the conglomerate ores, along the water courses, either at their present level or more often at that of some time prior to the erosion of its present channel. As has already been stated, these deposits are found cresting a rude semicircle of hills, having for its diameter the Neches river, and are in fact the western extension of the deposits of Cherokee county." P. 308.

129. ————————

Reports on the Iron Ore District of East Texas, Part III. Description of Counties. Chapter XIII. Houston County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 318-325. Austin, 1891.

Contents: Introduction. General Geology. Iron Ores. Soils. Building Stone.

"Lying immediately south of Anderson county, and situated like it between the Trinity river on the west and the Neches on the east, is Houston county. This county, which has a total area of eleven hundred and seventy-six square miles, is bounded on the south by Trinity county, and is the most southwestern county of the iron ore district, as far as we were able to ascertain during the past field season." P. 318.

"The only iron ore areas so far examined in this county are found in a series of oval shaped hills which extend in a northeast and southwest direction across the county north of Crockett." P. 319.

"In this county, so far as our investigations have shown, we have represented only strata of the Tertiary and Quaternary age.

"The general section is:

DUMBLE, EDWIN T.

Quaternary	....	Orange Sands.
Tertiary	....	Iron Ores. Fayette Beds. Timber Belt Beds.

P. 319.

130. ——————, State Geologist.

Geological Survey of Texas, Second Report of Progress, 1891, 91 pp. Austin, 1892.

Letter of Transmittal (Commissioner John E. Hollingsworth to Governor James S. Hogg). Letter of Transmittal (State Geologist E. T. Dumble to Hon. Jno. E. Hollingsworth, Commissioner). Contents—Report of the State Geologist. Report of Mr. W. H. von Streeruwitz. Report of Mr. W. F. Cummins. Report of Mr. Theo. B. Comstock. Report of Mr. W. Kennedy. Report of Mr. J. A. Taff. Report of Mr. J. A. Singley.

131. ——————, State Geologist.

Sources of the Texas Drift.

Transactions of the Texas Academy of Science, Vol. I, No. 1, pp. 11-13. Read March 5, 1892.

"This paper is designed to indicate, only in the most general way, the sources from which some of the drift materials have been derived, which are found so widely scattered over Texas."

Four districts are recognized, viz.: Trans-Pecos Texas, the region between the Nueces and the Brazos, that between the Brazos and the Sabine, and Northwest Texas. The author describes the drift material of each area and discusses its origin.

132. ——————, and CUMMINS, W. F.

The Double Mountain Section.

Amer. Geologist, Vol. IX, pp. 347-351; 1 plate. Minneapolis, June, 1892.

Party left Abilene in October, 1889. Double Mountain (in reality three mountains) is situated in Stonewall county between Double Mountain Fork and Clear Fork of the Brazos river. The expectation was to find the contact between the Permian and any Triassic or Jurassic, and the overlying Cretaceous. No Jurassic found. A section of these mountains is of interest "since it is the most northern point in this northwestern portion of the State at which the beds of the Lower Cretaceous are exposed, and the most easterly exposure of the Trias which we have been able to recognize." General Section described. Cretaceous. (1) Caprina Limestone, (2) Comanche Peak Series, (3) Trinity Beds. Triassic. (3a) Dockum. Permian. (4) Shaly Clay, (5) Upper Gypsum Beds, (6) Middle Gypsum Beds, (7) Lower Gypsum Beds.

133. DUMBLE, EDWIN T., State Geologist.

Third Annual Report of the Geological Survey of Texas, 1891. Austin: Henry Hutchings, State Printer. 8 vo., pp. xlix, 410, pl. xvi. 1892.

Letter of Transmittal to the Governor (Hon. James S. Hogg) by Jno. E. Hollingsworth, Commissioner of Agriculture, Insurance, Statistics and History. Financial Statement. Letter of Transmittal to the Commissioner of Agriculture, etc., by E. T. Dumble, State Geologist.

Contents: Report of the State Geologist for 1891. Reports of Geologists: W. H. Streeruwitz, Theodore B. Comstock, W. F. Cummins, W. Kennedy, J. A. Taff, L. E. Magnenat (Chemist). Accompanying Papers: Houston County, by W. Kennedy; Section from Terrell to Sabine Pass, by W. Kennedy; Llano Estacado or Staked Plains, by W. F. Cummins; Notes on the Geology of the Country West of the Plains, by W. F. Cummins; Stratigraphy of the Triassic Formation of Northwest Texas, by N. F. Drake; Report on Paleontology of the Vertebrata, by E. D. Cope; Shells Collected in the Sand of a Dry Salt Lake near Eddy, New Mexico, by Dr. V. Sterki; Reports on the Cretaceous Area North of the Colorado River. I. The Bosque Division. II. The Lampasas-Williamson Section, by J. A. Taff; Trans-Pecos Texas, by W. H. von Streeruwitz.

Noticed in Amer. Geol., Vol. X, pp. 311-316, 1892; Eng. and Min. Jour., N. Y., Vol. 54, p. 603, 1892; Amer. Jour. of Science, III, Vol. XLIV, p. 427, Nov., 1892.

134. ——————

Report of the State Geologist.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. xvii-xlix. 1892.

Contents: Introductory. Work of the Third Year: Topography. Geology—East Texas; Central and West Texas; Central Cretaceous area; Trans-Pecos Texas; Galveston Artesian well. Lignite Investigation—European Brown Coal; Uses of European Brown Coal; Comparison of European and Texas Lignites; Utilization of Texas Brown Coal. Paleontology. Chemical Laboratory. Library. Museum. Co-operation with the public high schools. Office work. Publications. Acknowledgments.

135. ——————, State Gelogist.

Report on the Brown Coal and Lignite of Texas. Character, Formation, Occurrence and Fuel Uses. 8 vo., pp. 243, pl. xxv. Austin, 1892.

Letter of Transmittal, Hon. Jno. E. Hollingsworth, Commissioner of Agriculture, etc., to the Governor, Hon. Jas. S. Hogg. Letter of Transmittal, E. T. Dumble, State Geologist, to Hon. Jno. E. Hollingsworth, Commissioner of Agr., etc.

Contents: Chap. I. Introductory and Historical. Chap. II. Brown Coal.—Its Origin, Formation, Physical and Chemical Character. Chap. III. Brown Coal as Fuel.—Direct firing with brown coal; gas firing with brown coal. Chap. IV. Brown Coal as Fuel—continued. Chap. V.

DUMBLE, EDWIN T.

Brown Coal as Fuel—continued. Chap. VI. Geology of the Brown Coal Deposits of Texas. Chap. VII. Occurrence and Composition of the Brown Coals of the Tertiary. Chap. VIII. Occurrence and Composition of the Brown Coals of the Tertiary—continued. Texas Brown Coal compared with European and with Bituminous Coal. Chap. X. Utilization of Texas Brown Coals.

"The aggregate area [in Texas] which is underlaid by beds of fossil fuels is very large. In the northern central portion of the State the coals of the Carboniferous or Coal Measures occupy an area of several thousand square miles. In this area there are nine distinct seams of coal, two of which are of workable thickness and of good quality (Second Ann. Rept. Geol. Surv. of Texas, p. 359 *et seq.*). A second, but as yet unexplored, basin of similar age occurs on the Rio Grande border in Presidio county. These are, however, somewhat distant from many localities at which are found ores and materials which would afford bases for great industrial development with proper fuel supply.

"In the vicinity of Eagle Pass, on the Rio Grande, there is a third basin containing a vein of good coal in beds which belong to the upper part of the Cretaceous formation (First Rept. of Progress, Geol. Surv. Texas; First Ann. Rept. Geol. Surv. of Texas; Notes on the Geology of the Valley of the Middle Rio Grande, E. T. Dumble).

"By far the most extensive beds, however, are those occurring in the Tertiary area, which stretches entirely across the State from Red River to the Rio Grande (First Rept. of Progress, Geol. Surv. Texas; First Ann. Rept. Geol. Surv. Texas; Second Ann. Rept. Geol. Surv. Texas; Utilization of Lignites, E. T. Dumble), and in which the coal beds frequently show a thickness of ten to fourteen feet in a single bank, with a total thickness in certain localities of from eighteen to twenty-four feet. These constitute, therefore, the greatest and most widespread fuel supply which is found in the State, and the desirability of utilizing these deposits for manufacturing and domestic purposes has naturally suggested an examination into the possibility of doing so." Pp. 17-18.

This volume is noticed in the Amer. Naturalist, Vol. 27, p. 379.

136. ——————

Volcanic Dust in Texas.

Transactions of the Texas Academy of Science, Vol. I, Pt. 1, pp. 33-34. Read June 14, 1892.

"During the field season of 1891, a number of specimens of a material nearly white in color and of light specific gravity were collected by Messrs. Kennedy and Walker from different localities in the Tertiary area, over which they were working. From their general appearance they were supposed to be diatomaceous earth, and under the microscope several of the specimens proved to be composed of diatoms. Other specimens, however, did not show any such forms at all, but consisted of the flat transparent, sharply angular particles with striated or pitted surfaces peculiar to volcanic dust, and it was so determined by Prof. F. W. Cragin.

"These deposits were apparently, but not certainly, all interstratified

DUMBLE, EDWIN T.

among the clays and sands which we have designated the Fayette beds, and which are probably of Miocene age." P. 33.

For description of the Fayette Beds, see Penrose, "A Preliminary Report on the Geology of the Gulf Tertiary of Texas from the Red River to the Rio Grande," First Annual Report of the Geological Survey of Texas, pp. 47-58.

A section on O'Quinn creek, a branch of Buckner Creek, is given, showing the position of the "volcanic dust" which, in this locality, is immediately beneath a layer of Brown Coal, "somewhat lignitic in places, but generally compact and massive," and above "Brown Coal, somewhat variable, with small inclusions of members of the group of asphaltums."

137. ————————

Note on the Occurrence of Grahamite in Texas.

Trans. Amer. Inst. Mining Engineers, Vol. XXI, pp. 601-605. 1892.

(Schuylkill Valley Meeting. Reading, Oct., 1892.)

"The first specimens of this material which came under my notice, as found in the State of Texas, were sent to me by Mr. J. C. Melcher, of Fayette county, soon after the organization of the State Geological Survey. * * *

"Later specimens were collected by Dr. Penrose and myself on a trip made by boat down the Rio Grande, from Eagle Pass to Hidalgo, in June, 1889. At the time of collection I marked the substance 'Albertite,' doubtfully, but, on examination, it proved to be nearer Grahamite.

"The geological horizon of the two occurrences is Tertiary. The first locality mentioned is in the upper part of the beds called by us the Fayette beds, and provisionally correlated with the Miocene, or Grand Gulf of Hillgard's Mississippi section, while the latter is in the lowest strata of the Eocene which are exposed on the Rio Grande river, and which may be taken as equivalent to the basal Claiborne, if not lower."

Detailed account of the Webb County Grahamite. Section at Webb Bluff.

Detailed account of the Fayette County Grahamite. Section at O'Quinn Creek.

Analyses of these Grahamites by L. E. Magnenat.

WEBB COUNTY GRAHAMITE.

PROXIMATE ANALYSIS.

Moisture	0.30
Volatile Matter	44.00
Fixed Carbon	52.80
Ash	2.90
	100.00
Total Sulphur	5.42

ULTIMATE ANALYSIS.

Carbon	78.65
Hydrogen	7.50
Nitrogen	0.15
Oxygen	5.08
Sulphur	5.42
Ash	2.90
Water	0.30
	100.00

DUMBLE, EDWIN T.

FAYETTE COUNTY GRAHAMITE.

PROXIMATE ANALYSIS.

		Sulphur.
Moisture	None.	None.
Volatile Matter	57.90	2.50
Fixed Carbon	37.70	4.71
Ash	4.40	0.24
	100.00	
Total Sulphur		7.45

ULTIMATE ANALYSIS.

Carbon	76.19
Hydrogen	6.61
Nitrogen	0.39
Oxygen	5.15
Sulphur	7.45
Ash	4.21
	100.00

138. ——————

The Reading Meeting of the Institute of Mining Engineers. Note on the Occurrence of Grahamite in Texas.

Engineering and Mining Journal, Vol. 54, p. 368. N. Y., October 15, 1892.

A brief notice of the preceding paper.

139. ——————

Notes on the Valley of the Middle Rio Grande.

Bulletin Geol. Soc. Amer., Vol. III, pp. 219-230. 1892.

Remarks by W. J. McGee. Ib., p. 483.

Contents: Introduction. Topography. Geologic Structure. Lower Cretaceous, Upper Cretaceous—The Val Verde Flags, The Pinto Limestone, The Eagle Pass Division: Upson Clays, San Miguel Beds. The Coal Series, Escondido Beds. The Upper Cretaceous Section. Reynosa Beds. Correlation of Rio Grande and Colorado River Sections.

This paper is based in part upon observations made during a trip by row boat from Eagle Pass to Edenburg in May and June, 1889, and in part upon field work in the region between Eagle Pass and Del Rio during the summer of 1891.

A portion of the area having been described by Dr. R. A. F. Penrose, Jr., the author confines himself "to that part of the river between San Filipe Creek, near Del Rio, and Webb Bluff, three miles below the southern line of Maverick county." The distance between these points in a straight line is over 81 miles; by river probably 120 miles.

140. ——————

Progress of Geological Surveys, Texas.

Engineering and Mining Journal, N. Y., Vol. 55, p. 55. Jan. 21, 1893.

An account of the work and personnel of the Geological Survey of Texas for the fourth year. (1892.)

141. ——————, and HARRIS, G. D.

The Galveston Deep Well.

Amer. Jour. of Science, III, Vol. XLVI, pp. 38-42. New Haven, July, 1893.

The Section.—E. T. Dumble.
The Paleontology.—Gilbert D. Harris.

DUMBLE, EDWIN T.

A condensed section of the well for 3,070 feet, with notes, is given by Mr. Dumble, while the conclusions drawn from a study of the molluscan remains are summarized by Mr. Harris.

See Harris' "Preliminary Report on the Organic Remains Obtained from the Deep Well at Galveston, together with conclusions respecting the Age of the various formations penetrated."

Fourth Ann. Rept. Geol. Surv. of Texas, 1892, Pt. I, pp. 117-119. 1893.

142. ————————, State Geologist.

Fourth Annual Report of the Geological Survey of Texas, 1892, 8 vo., pp. xxxv, 474. Austin: Ben C. Jones & Co., State Printers. 1893.

Letter of Transmittal to the Governor (the Hon. J. S. Hogg) by John E. Hollingsworth, Commissioner of Agriculture, Insurance, Statistics and History. Financial Statement. Letter of Transmittal to the Commissioner of Agriculture, etc., by E. T. Dumble, State Geologist.

Table of Contents: Report of State Geologist. Accompanying Papers: Part I—Geology. Report on Grimes, Brazos, and Robertson Counties, by W. Kennedy. Preliminary Report on the Artesian Wells of the Gulf Coastal Slope, by J. A. Singley. Preliminary Report on the Organic Remains obtained from the Deep Well at Galveston, together with conclusions respecting the Age of the Various Formations penetrated, by Gilbert D. Harris. Report on the Rocks of Trans-Pecos Texas, by A. Osann. Trans-Pecos Texas, by W. H. Streeruwitz. Notes on the Geology of Northwest Texas, by W. F. Cummins. Report on the Cretaceous Area North of the Colorado River, by J. A. Taff. Report on the Colorado Coal Field of Texas, by N. F. Drake. Report on the Soils, Water Supply, and Irrigation of the Colorado Coal Field, by R. A. Thompson. Part II—Paleontology and Natural History. A Preliminary Report on the Vertebrate Paleontology of the Llano Estacado, by E. D. Cope. A Contribution to the Invertebrate Paleontology of the Texas Cretaceous, by F. W. Cragin. Contributions to the Natural History of Texas, by J. A. Singley. Part I. Texas Mollusca. Part II. Texas Birds. Carboniferous Cephalopods. Second Paper, by Alpheus Hyatt.

Noticed in Amer. Jour. of Science, III, Vol. XLVII, p. 319, April, 1894.

143. ————————

Report of the State Geologist.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, pp. xvii-xxxv. Austin, 1893.

Contents: Introduction. Work of Fourth Year; Topography; Stratigraphical Geology; Petrography; Chemical Laboratory; Paleontology; Natural History; Museum; Library; Co-operation with Public Schools; Publications; Office Work.

144. ————————, State Geologist.

Introduction [to Cope's Preliminary Report on the Vertebrate Paleontology of the Llano Estacado.]

DUMBLE, EDWIN T.

Fourth Ann. Rept. Geol. Surv. of Texas, Pt. II, pp. 3-9. Austin, 1893.

A review of the geology of the Llano Estacado Region with a brief account of the work done previous to the establishment of the State Geological Survey, and that done since its establishment.

145. ——————, and CUMMINS, W. F.

The Kent Section and Gryphæa Tucumcarii, Marcou.

Amer. Geologist, Vol. XII, pp. 309-314. Minneapolis, Nov., 1893.

Kent is a station on the Texas and Pacific Railroad 163 miles east of El Paso (in El Paso county near the Jeff Davis county line). It is situated on the northeast slope of the Davis mountains. The railroad follows a valley eroded in the Cretaceous foothills. The section here described is found in these hills north and south of the road within the radius of a mile of the depot.

The Kent Section in detail, which includes beds belonging to the Washita, Fredericksburg and Bosque Divisions of the Cretaceous, with an enumeration of their fossil contents. A table showing the recorded stratigraphic range of in Texas of the fossils found in the Washita division of the Kent section. This section extends the range of *Cerithium bosquense, Cyprimeria crassa,* and *Exogyra plexa,* and gives the horizon of *Diplopodia streeruvitzii* and *Plicatula incongrua.*

146. ——————, State Geologist.

Notes on the Texas Tertiaries.

Transactions of the Texas Academy of Science, Vol. I, No. 3, pp. 23-27. Read June 19, 1894.

"In my report on the geology of Southwest Texas, which is now awaiting publication as a part of the Fifth Annual Report of the Geological Survey of Texas [not published owing to the discontinuance of the Survey.—F. W. S.], I have proposed a division of the Tertiary and later deposits of the Coastal Plain somewhat different from that which has been used in previous reports. This change was made necessary by the new stratigraphic evidence secured in making the Nueces section and the results of the studies of our collections of fossil shells from various localities in this area by Prof. Gilbert D. Harris.

"These divisions, with such correlation as seems to be warranted by the facts, now before us, are:

Pleistocene	Coast sands, stream deposits, etc.	
	Coast clays	Port Hudson.
	Equus beds.	
Neocene	Reynosa-Orange Sand.	
	Lagarto.	
	Lapara	Blanco.
	Oakville-Deep Well.	
Eocene	Frio	Lower Claiborne.
	Fayette	
	Yegua	
	Marine	
	Lignitic	Lignitic.
	Basal Clays	Midway."

DUMBLE, EDWIN T.

Following a brief general discussion of the Fayette and beds above it, a detailed description is given of the Reynosa-Orange Sand, Lapara-Lagarto Beds. Oakville Beds and Frio Clays as they occur along the line of the International and Great Northern Railroad from Houston to Palestine. The paper concludes with a correlation of the beds of the Pleistocene and Neocene, as above given, with those of the Galveston Deep Well.

147. ————————

The Cenozoic Deposits of Texas.
Journal of Geology, Vol. II, pp. 549-567. Sept.-Oct., 1894.

Contents: Eocene—Basal Clays (Characteristic Fossils), Lignitic Beds (Fossils), Marine Beds (Characteristic Fossils), Yegua Clays (Characteristic Fossils), Fayette Sands (Characteristic Fossils), Frio Clays. (The Texas Eocene considered as a Whole. Fossils in common with similar beds on the Pacific Coast according to G. D. Harris.) Neocene: Miocene; Pliocene; (The Vertebrate Fauna of the Blanco Beds). The Lapara Division, The Lagarto Division, Reynosa Division. Pleistocene—Equus Beds, (Fossils described from the Plains; from the San Diego Beds; Shells collected from the upper part of the San Diego Beds determined by J. A. Singley.) Coast Clays. (The Seymour Plateau.) Conclusion.

"The purpose of this paper is to give a brief account of the Cenozoic deposits of Texas as they are now understood, and to make such correlation of the various horizons as may appear to be warranted by the stratigraphical position and fossil contents." P. 549.

148. ————————

Some Sources of Water Supply for Western Texas.
Condensed Report of the Proceedings of the State Irrigation Convention convened at San Antonio, Texas, December 4, 1894, pp. 85-94. San Antonio, 1894.

An account of a trip northward from Carrizo Springs through Dimmit and Zavala counties. The contrast between the valleys of the Nueces and the Leona due to irrigation in the latter. The region considered: "That portion of Southwest Texas west of the 98th meridian and south of parallel 30; and the Trans-Pecos region.

"The more eastern of these two regions may be most concisely described as consisting of plains and valleys in plains. One of the greater of these plains occupies the larger part of the area north of the Southern Pacific Railway. On some of the older maps it is represented as stretching westward to, and forming part of, the Guadaloupe mountains, and is called by that name. It is a great plateau with a comparatively level surface, which is deeply scored by cañons towards its southern border. Along this border, in many places, it rises abruptly 100 feet or more above the valley at its base. Its elevation above the sea level is somewhat over 2000 feet.

"The other principal plain of the area is that of the coastal slope. This rises gradually from the gulf shore until in the western portion of the

DUMBLE, EDWIN T.

area it reaches an elevation of over 800 feet. Like the Guadalupe plateau, it also breaks abruptly down into the valley at its foot. Its former extent was much greater than the present, for it reached inward and covered all the intervening country to the base of the Guadalupe plateau." * * *

The Trans-Pecos region may be said to comprise plains and mountains in plains.

Sources of water supply: Surface water, subterranean water. The River Systems: Colorado, Guadalupe, Nueces, Rio Grande. Their drainage. The Guadalupe Plateau—its Springs. The volume of water in the Rio Grande greatest, but the topography of the adjacent country does not permit its extended use. The supply is ample for the immediate valley. The real importance of the Guadalupe system in agricultural development not yet recognized.

The main river system of the region is the Nueces. Its origin. Intermittent flow of its branches. The storage of water suggested by building dams in the canyons. Site for a dam on the Rio Grande.

Artesian Conditions. The great springs found along the foot of the plateau are artesian. "When the lowland or valley is reached, this same water-bearing bed can be found by boring wells to it, and in many places it affords very strong flows. The water of the artesian wells of San Antonio is supplied from some of these beds, although there is a little uncertainty as to their exact horizon. Similar wells can be had at many places along the line of the Southern Pacific railroad west to Uvalde, or between that line and the foot of the plateau."

The Water-bearing Sands of the Tertiary. Dip towards the Gulf. "The most northern of these, and the most important as well, occupies a belt of country from Calaveras, on the San Antonio river, by the way of Rossville, Devine, Batesville, and Carrizo Springs to the Rio Grande." Water from the upper part of the beds usually somewhat mineralized.

"The next water-bearing sand is that belt of brown sandstone which is seen all along the International and Great Northern railroad from Cotulla to Laredo." Small flows.

"The third belt is the sandy portion of the Fayette beds. These beds contain more clay than do the Carrizo beds, and are not so free of deleterious matter, consequently while they will furnish artesian water at many localities, it may in many places be mineral water." The Oakville beds might be expected to furnish water in the coastal region—in some cases salt water.

The Reynosa Sand.

Trans-Pecos Texas. No artesian water. Topography. Suggested dam sites. Storm waters its only hope.

149. ————

Some Sources of Water Supply for Western Texas.

See the preceding paper.

The San Antonio Daily Express, Wednesday, Dec. 5, 1894.

150. DUMBLE, EDWIN T.

Volcanic Dust in Texas.

(Correspondence.)

Science, N. S., Vol. I, pp. 657-658. June 14, 1895.

Reference is made to an article by Mr. Henry W. Turner bearing the same title (Science, N. S., Vol. I, pp. 453-455).

The first specimen of the material was received by the Texas Geological Survey February, 1900. It was collected by Mr. W. F. Cummins from his "Blanco Canyon beds." In the microscopic slides prepared by the Survey diatoms were found in abundance.

"These diatoms were partially identified by Mr. C. H. Kain and published by Prof. Cope in his first notice of the probable Pliocene age of the Blanco Canyon beds (Proc. Amer. Phil. Soc., 1892, p. 123).

"The diatomaceous character of this material was further noted by Messrs. Lewis Woolman and C. Henry Kain, and the list of species given in the *American Naturalist* for 1892 [Vol. XXVI], p. 505, under the title 'Fresh-Water Diatomaceous Deposit from Staked Plains, Texas.'

"In 1892, an examination of this material by the writer (Dumble) showed the presence of volcanic dust, but the diatoms constituted by far the greater part of the mass examined, and it was therefore classed with other materials of a similar kind from the coast region as diatomaceous earth, and only those siliceous deposits of like character which failed to reveal diatoms were classed as volcanic dust and briefly described in the Transactions of the Texas Academy of Science (Vol. I, Pt. I, p. 33. 1892). Further reference to these siliceous deposits are also made by Kennedy in the Fourth Annual Report Geol. Surv. Texas, pp. 20, etc.

"The stratigraphic position of the deposit referred to by Mr. Turner has been accurately determined. * * *" Reference to the Reports of Prof. Cummins. Fossils of the Blanco Canyon beds. Quotation from Cope.

151. ——————, State Geologist.

The Soils of Texas. A Preliminary Statement and Classification.

Transactions of the Texas Academy of Science, Vol. I, No. 4, pp. 25-60; map. Read June 18, 1895.

Contents: Introduction. Soils and their Derivation. Geology. Physical Geography. Residual Soils of the Coastal Slope: Soils of the Coastal Prairies. Soils of the Tertiary Plain—The Reynosa or LaFayette; Oakville or Grand Gulf; Frio Clays; Fayette Sands; Yegua Clays; Marine Belt; Lignitic Belt. Soils of the Black Prairie—Ponderosa Marls; Austin Chalk; Eagle Ford Shale; Lower Cross Timbers. Soils of the Grand Prairie—Vola and Arietina; Washita Limestone; Fredericksburg; Bosque. Residual Soils of the Central Basin: Soil of the Denuded Areas—Coal Measures; Permian. Soils of the Plateaus—Cretaceous; Llano Estacado. Residual Soils of the Mountain Regions: Central Mineral Region; Trans-Pecos Region. Soils of Transportation: Drift Soils—Coastal Slope; Central Basin. Alluvial Soils—Coast Prairie Streams; Streams of Reynosa Plain; Rivers of the Grand Prairie; Rivers of the Basin Region. Preliminary Classification of Texas Soils. Conclusion.

This paper contains numerous soil analyses taken from "Cotton Pro-

DUMBLE, EDWIN T.

duction," 10th Census, Bulletin No. 25 of the Texas Agricultural Experiment Station, and the Publications and Records of the Geological Survey of Texas.

152. ——————

Cretaceous of Western Texas and Coahuila, Mexico.
Bull. Geol. Soc. Amer., Vol. VI, pp. 375-388. 1895.

Contents: Introduction. Localities of Occurrence, Character and Relations of the Rock. San Lorenzo Section—Its Location and the Character of the Country; Details of the Section. Lower Cretaceous; Bosque Division—Its Members; Flat Mesa Sections; Kent Sections; Exposures in the Arboles and Burras Mountains; Episodes of the Bosque Period. Fredericksburg Division—West of the Pecos River; In the San Lorenzo Section; *Caprina crassifibra* as a Criterion of Fredericksburg Age; The Kent Locality. Washita Division—in the Trans-Pecos Area; At the Kent Locality; Devil's River Section; in the San Lorenzo Section; The Finley-Eagle Mountains Section; Comparisons with other Localities. Upper Cretaceous: Geologic Succession and Correlations; Dakota Division; Colorado Division; Montana Division—Its Importance; Areas Investigated by the Author; General Section; Fossils; Dikes; Folds; Faults, and Lava Flows.

"While in its broader features the Cretaceous of Western Texas and of the northern portion of the Mexican State of Coahuila corresponds closely with that of the Colorado River section east of it, there are, nevertheless, many important differences in the stratigraphy and faunal relations well worth more detailed study than they have yet received. A few of these differences, which have come under my personal observation during trips made through various parts of the region, are presented as indicating the general character of the formation.

"Only a few remnants of areas are found north of the Texas and Pacific railroad, and that line may well be taken as marking the northern boundary of the Cretaceous deposits of Western Texas, since, as a body, they pass north of it only (if at all) under that portion of the road which crosses the Llano Estacado." P. 376.

The San Lorenzo Section was made in northern Coahuila, Mexico.

153. ——————

Texas Brown Coal.
Eng. and Mining Journal, Vol. LXII, p. 343. N. Y., Oct. 10, 1896.

Attention is called to the constantly increasing use of brown coal as a fuel. After being tried with success under stationary boilers its use has extended to locomotives on railroads. The subject of "Brown Coal and Lignite" is treated by Mr. Dumble in a volume bearing that title published by the State Geological Survey in 1892. The comparative value of brown coal and bituminous coal is there given at 7 to 10. "In engine performance it is found that 1.4 tons of brown coal yield the same results as one ton Indian Territory coal. Taking the cost of the two fuels into

DUMBLE, EDWIN T.

consideration, this means a saving of fully one-third of the former fuel bills by using brown coal, an item worth working for.

"While these results are eminently satisfactory and promise a rapid advance in brown-coal mining in the State, I am still of the opinion that before it can attain its best development plants must be erected for converting it into compressed fuel in order to decrease its present tendency to slack and fall to pieces on exposure to the air."

154. ————————

The Iron Ores of Texas.

The Business Record, Vol. I, No. 3, p. 43. Houston, October, 1896.

"The iron ores of the State of Texas may be classed among the most valuable of her mineral deposits. While as yet their utilization has attained only very modest proportions, the cause of this is not found in either the quantity or quality of the ores themselves.

"By the work of the geological survey, the iron ore areas of East Texas and of the Llano or central mineral regions have been clearly defined, mapped, and described, and from this work and the developments which have been made by the furnaces in the different localities in East Texas, we are justified in the statement, that there is in the deposits themselves, when considered either as to quality or quantity, every opportunity for the development of an iron industry equal to any in the Southern States."

The ores of Llano County: Magnetite, Hematite, and some Limonite. There are four belts: Babyhead, the most easterly; that between Packsaddle and Riley mountains; Iron Mountain; that between Riley Mountain and Enchanted Rock.

"The supply of the very best Bessemer ore is sufficient to build up very extensive industries, when it shall have been properly opened, and will supply all possible needs for many years to come."

The ores of East Texas. All hydrated—limonite known as Nodular and Laminated ore.

"The character of these ores is fully revealed in their names, the nodular occurring as nodules or boulders, and the laminated in more continuous beds. While they occur together to more or less extent, the nodular ores prevail in the northeastern part of the district, their principal areas being in Cass and Marion counties, with smaller areas in Morris, Upshur, Harrison, etc. These nodular ores are found imbedded in sand, in separated deposits, with considerable areas of barren country intervening. These deposits vary in area from 10 to several hundred acres, and have a thickness from one to five feet.

"The laminated ores, which prevail over by far the greater portion of the one thousand square miles which is underlaid by workable ores in this region, reaches its greatest development in Cherokee county."

The nodular ore seems to average richer in metallic iron and lower in Phosphorus than the laminated. Factors that have retarded the development of the iron industry in Texas: Fuel, fluxing materials, transportation, and market. There is a want of fuel in the Llano region. The

DUMBLE, EDWIN T.

timber of East Texas affords a charcoal supply, but the making of charcoal is too costly. This region is without limestone for flux, which must be transported. The State experiment in making charcoal. The use of brown coal or lignite is advocated. Coking coal from the Brazos Coal Field.

155. EAKINS, L. G.

(Analysis of Gadolinite from Llano County, Texas.) See Hidden, W. E., and Mackintosh, J. B. A Description of Several Yttria and Thoria Minerals from Llano County, Texas.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 474-486. December, 1889.

This analysis was privately communicated to the authors of the above paper by Professor F. W. Clarke, and published by them, together with an analysis by Dr. F. A. Genth (see Genth, F. A., in this Record), for comparison with their own results. P. 479.

GADOLINITE, LLANO COUNTY, TEXAS.

Sp. gr.=4.239.*.

		Oxygen Ratio.		
"SiO_2	23.79			79.30
ThO_2	0.58		0.44	
MnO	trace			
FeO	12.42	17.25		
GlO	11.33	45.18		
CaO	0.74	1.32	63.75	121.13
MgO	traces			
K_2O	traces			
Na_2O	traces			
Al_2O_3				
Fe_2O_3	0.96	1.80		
Ce_2O_3	2.62	2.43	56.94	
$(Di\,La)_2O_3$	5.22	4.77	†	
$(Y, Er)_2O_3$	41.55	47.94	‡ §	
H_2O	1.03			
P_2O_5	0.05			
Insoluble				
	100.29"			

"* At 17° C.

† Didymium spectrum very strong.

‡ Molecular weight=260.

§ Erbium spectrum weak."

156. EMMONS, S. F.

Orographic Movements in the Rocky Mountains.

Bulletin Geol. Soc. Amer., Vol. I, pp. 245-286. 1890.

Reference is made to Texas and Arkansas on pp. 275-276 based upon Professor Hill's paper in *American Journal of Science*, III, Vol. XXXVIII, 1889, p. 468.

EMMONS, S. F.

"Recent geological observations in Texas and Western Arkansas show, according to Mr. R. T. Hill, that the marine Cretaceous beds of that region have been deposited along the southern base of an uplift, as yet imperfectly known, of Paleozoic rocks, extending from Arkansas westward through Indian Territory and Northern Texas, and southwestward into New Mexico. It is not yet definitely known whether early Mesozoic beds are involved in this uplift so that its formation could be correlated with the Jurassic movement in the Rocky Mountain region, though certain facts render this probable."

The question of the correlation of the Texas Cretaceous beds is also briefly discussed.

157. ENGINEERING AND MINING JOURNAL.

New Yttria and Thoria Minerals.

Vol. XLIX, p. 338. March 22, 1890.

"W. E. Hidden and J. B. Mackintosh have found three new minerals in the locality near Bluffton, Llano county, Texas, which has lately yielded unusual quantities of minerals of the rarer earths—yttrialite, a thorium-yttrium silicate; Thorogummite, a hydrated uranium thoro-silicate; and nivenite, a hydrated thorium-yttrium-lead silica. Besides these new species, the locality has produced considerable quantities of gadolinite, fergusonite and other heretofore rare minerals. A full account is given in the *American Journal of Science,* to which periodical Dr. Genth had contributed a paper on the Texas gadolinite in September, 1889. The locality is mineralogically remarkable, and furnishes a great variety of specimens. The country rock is a red granite, traversed by numerous quartz veins, in the pockets of which the yttria and thoria minerals occur."

158. ——————

Cinnabar in Texas.

Vol. 58, p. 202. N. Y., Sept. 1, 1894.

An announcement of the confirmation of the rumors concerning "the occurence of cinnabar in the southern portion of Presidio county, Texas, not far from Presidio del Norte, in the big bend of the Rio Grande."

159. ——————

General Mining Notes.

(Coal in Texas.)

Vol. 58, p. 207. 1894.

Extract: "There is coal on the Texas side of the Rio Grande near Eagle Pass—of the 'Fox Hills Group.' There is also coal at Santo Tomas, near Laredo (lignite); also at Presidio del Norte (between Eagle Pass and El Paso, near Rio Grande). At Thurber, on the Texas and Pacific, west of Fort Worth, the Texas and Pacific Coal Company is an extensive producer, about 1000 tons a day."

160. ——————

The Texas and other American Sulphur Deposits.

Vol. LXII, p. 26. July 11, 1896.

ENGINEERING AND MINING JOURNAL.

Reference is here made to a report by Dr. Eugene A. Smith, State Geologist of Alabama, on the Sulphur Deposits of Texas, from which several extracts are taken. The information given does not differ materially from that contained in his paper entitled "Notes on Native Sulphur in Texas." (See Smith, Eugene A., in this Record.)

"These deposits have also been examined by Mr. John E. Rothwell, mining engineer of Denver, Colo., also a careful and competent expert. He tested the property by boring and shafts, and proved a still larger quantity of sulphur 'in sight' than did Dr. Smith, so that there can be little doubt as to this being a valuable deposit. These beds have easy access to tide water and the Mississippi river, and consequently have low freights to many of the most important markets for this material. Their exploitation, therefore, offers the foundation of a prosperous industry."

Reference is also made to the deposits of Utah, Lower California, Louisiana, and the West Indies.

161. EVERHART, EDGAR.

Contributions from the Chemical Laboratory, University of Texas, Bulletin No. 4, pp. 18. n. d. (1888?).

Contents: Petroleum of Texas; Kaolin; Silver and Gold; Iron Ores; Ochres; Coal; Mineral Waters—Chalybeate Water, Alum Water, Alkaline Sulphatic Water; Sulphur Water.

"For many years it has been known that there were various localities in the State where an oily substance exuded from the ground. These places were generally denominated 'tar springs.' Mention is frequently made of these springs in the various histories of Texas. Ex-Gov. Roberts, in his 'Description of Texas,' states that on the Gulf coast not far from Sabine Pass so much of this tarry matter issues from the ground that during storms the water of the Gulf is frequently calmed by the floating oil.

"The tar spring near San Augustine has long been known, and utilized to some extent for various purposes, principally as a lubricant.

"Near Burnet there are several places where this tarry substance issues from the ground, forming at times considerable springs. One of these places is situated near the top of a high hill overlooking the town, while in the valley below, on the banks of a small creek, there are also several springs.

"Near Palestine there are said to be strong indications of petroleum, but nothing definite regarding them has been heard here.

"In the vicinity of Austin, near Walnut Creek, prospecting for oil is going on, probably with some hopes of success. About one and a half miles north of Austin a gentleman, in sinking a well, at the depth of fifty feet struck water which is strongly impregnated with petroleum. The water is unfit for drinking purposes. A sample of the water was examined in the laboratory, and an oil was found in small quantities which resembles the crude oil of Pennsylvania. These are probably only a small fraction of the number of places in the State where petroleum may be found. * * *

EVERHART, EDGAR.

"In the early part of last year [1887] a company in Nacogdoches was formed to develop the petroleum deposits that were known to exist near that place. The springs are situated about thirteen miles from the town of Nacogdoches. Efforts have been made to learn something of the geological formations of the locality about the springs, but without success. The only thing in that connection that could be ascertained was with regard to the nature of the ground through which the wells were sunk. In driving the wells sand was encountered almost entirely. At some stages of sinking them the borers were troubled with quicksand, but not to a very great extent. In the deepest well, which goes to a depth of 360 feet, very hard rock was met with. The character of the rock is unknown to me. Probably the petroleum exists in the Tertiary formation.

"Since beginning the work the company have sunk eight wells, which vary in depth from ninety to one hundred and twenty feet, except in one instance where a depth of 360 feet has been attained. Owing to a want of facilities for handling and storing the oil, only two of the wells are at present in operation, the rest being securely capped. The daily yield of these two wells is, as I am informed, 250 barrels each.

"The wells that have been sunk will flow to some extent, but in order to increase the yield pumping has been resorted to. * * *

* * * * * * *

"The Texas oil is not adapted to the production of illuminating oil—its value consists in its use as a lubricant. There is probably no better lubricating material manufactured than this crude oil as it is pumped from the well.

"In order to investigate some of the properties of this oil a quantity was obtained from Nacogdoches and submitted to various tests in the University laboratory. The work was assigned to Mr. P. H. Fitzhugh, who conducted the tests under my direction.

"The oil has a brownish red color. The odor is peculiar, but not so offensive as the crude petroleum of Pennsylvania. At ordinary temperature the oil is mobile, but not so much so as ordinary petroleum. Submitted to an extreme cold the oil still retains its liquidity, but naturally becomes less mobile. The temperature of the oil was reduced to less than zero (Fahrenheit) without its losing its flowing qualities. At no temperature attainable in the laboratory by artificial means could any solid parafine be separated.

"The oil does not gum on exposure to the air.

"Mr. Fitzhugh subjected about four pounds of the oil to distillation over the naked flame, in a retort connected with proper condensers. The temperature was carried up to 680° Fahrenheit. At intervals of 45° Fahrenheit each distillate was removed and its weight determined. The results of the distillation were as follows:

1.	Below 300° Fahr., the distillate amounted to	0.04 per cent.
2.	300°—345° Fahr., the distillate amounted to	0.37 per cent.
3.	345°—390° Fahr., the distillate amounted to	1.30 per cent.
4.	390°—435° Fahr., the distillate amounted to	2.09 per cent.
5.	435°—480° Fahr., the distillate amounted to	3.14 per cent.
6.	480°—525° Fahr., the distillate amounted to	6.25 per cent.
7.	525°—615° Fahr., the distillate amounted to	7.07 per cent.
8.	615°—680° Fahr., the distillate amounted to	5.63 per cent.
	Remaining in the retort..................................	74.03 per cent.

EVERHART, EDGAR.

"A consideration of the above figures shows in the first place that the crude petroleum of Nacogdoches is practically free from naptha. Naptha distills off below 250° Fahr. Four pounds of this oil carried to a temperature fifty degrees higher yielded only a few drops of a light oil, amounting to but 0.04 per cent. of the total amount taken. In the Pennsylvania crude petroleum the illuminating oil comes off between 250° and 500° Fahr., and it on an average amounts to about 55 per cent. The Nacogdoches petroleum, between the same degrees of temperature, yields only a little over 7 per cent.

* * * * * * *

"*Kaolin.*—This valuable mineral is found in several different parts of the State. In some localities the quality is not sufficiently good for the manufacture of the finest grades of porcelain ware, but in at least three or four places large beds of Kaolin are found which are not surpassed, if, indeed, equaled, by any like deposits in the world. So far as can be judged from samples brought to this laboratory for analysis, it would appear that the central and eastern portions of the State yield Kaolins that are of medium quality only, while in the western portion the finest grades are found.

* * * * * * *

"The following Kaolins were obtained from the central part of the State. They are of medium quality. Their composition as determined by analysis is:

	A.	B.	C.
Water	5.45 per cent.	3.20 per cent.	2.69 per cent.
Alumina	13.83 per cent.	13.46 per cent.	12.71 per cent.
Oxide of iron	2.70 per cent.	2.01 per cent.	3.60 per cent.
Silica	68.25 per cent.	72.31 per cent.	72.56 per cent.
Lime	1.23 per cent.	0.82 per cent.	1.00 per cent.
Magnesia	0.47 per cent.	0.30 per cent.	0.10 per cent.
Potash	3.52 per cent.	3.07 per cent.	3.44 per cent.
Soda	3.96 per cent.	4.07 per cent.	2.62 per cent.
Sulphuric acid	0.30 per cent.	0.35 per cent.	0.10 per cent.
Oxide of manganese			1.00 per cent.
	99.71	99.59	100.02 [99.82]

"The two Kaolins whose analyses are given below are very fine. They are pure white in color, somewhat greasy to the touch, and are infusible in the hottest blowpipe flame. Being practically free from iron they are adapted to the making of the best grades of china. They are free from grit and every other objectionable impurity.

"One of the deposits at least is said to be of great extent.

"KAOLIN FROM NUECES CANYON.

Water	4.53 per cent.
Alumina	33.66 per cent.
Silica	46.60 per cent.
Lime	0.43 per cent.
Magnesia	0.96 per cent.
Soda	1.65 per cent.

EVERHART, EDGAR.

"KAOLIN FROM EDWARDS COUNTY.

Water	6.05	per cent.
Alumina	43.17	per cent.
Silica	48.41	per cent.
Lime	0.38	per cent.
Magnesia	0.10	per cent.
Alkalies	1.78	per cent.

Silver and Gold.— * * * "That there are such valuable deposits in the State, however, there can be no doubt, and analyses of gold and silver ores found in Texas of even great value have been made in the laboratory of the University. So far as my experience goes, the ores of both gold and silver are much more valuable in the western and northwestern portions of the State than in the central. Of many ores examined from Llano and the adjacent counties none of great value were found, although some were fair low grade ores. * * * In some of the streams of Llano county it is possible to pan out gold in even paying quantities, and it is to be hoped that the time is not far distant when competent geologists will be able to locate the source of this metal in that portion of the State.

"One of the most remarkable deposits of gold ever found is near Austin. It is remarkable from the fact that the gold is found in a kind of rock which has hitherto been supposed to be free from gold. The metal seems to be very unequally distributed through ordinary limestone, and does not occur in any well defined veins at all. This will probably prevent its successful working, for while one ton of the rock might yield $50 of gold, still the next ten tons would be likely to yield not a cent.

"From the extreme northwestern part of the State some very fine indications of gold have been found. A small nugget about as large as a pigeon's egg has been received at the laboratory. It is said to have been found in Oldham county.

* * * * * * *

"A few examples of the ores assayed for gold and silver are given:

"Silver ore from Northwest Texas showed 150 oz. of silver to the ton of 2000 lbs.

"Gold ore found in limestone contained: Silver, 6 oz. to the ton of 2000 lbs.; gold, $17 to the ton of 2000 lbs.

"ARGENTIFEROUS GALENA.

No. 1 contained 15 oz. silver to the ton of 2000 lbs.
No. 2 contained 20 oz. silver to the ton of 2000 lbs.
No. 3 contained 120 oz. silver to the ton of 2000 lbs.
No. 4 contained 10 oz. silver to the ton of 2000 lbs.
No. 5 contained 23 oz. silver to the ton of 2000 lbs.

"One of the richest silver ores it has ever been my lot to assay was found in this State, and it contained, according to the analysis, over 5000 oz. of silver to the ton.

"Iron Ores— * * *

"The following partial analyses of iron ores from different parts of the State will give some idea of their value:

EVERHART, EDGAR.

"BURNET COUNTY.

	No. 1.	No. 2.
Sulphur	0.002 per cent.	0.10 per cent.
Phosphorus	0.001 per cent.	0.08 per cent.
Silica	4.65 per cent.	2.46 per cent.
Oxide of iron	86.40 per cent.	87.43 per cent.
corresponding to		
Metallic iron	60.48 per cent.	61.00 per cent.

"GILLESPIE COUNTY.

Sulphur	0.01 per cent.
Phosphorus	0.05 per cent.
Silica	3.86 per cent.
Oxide of Iron	84.41 per cent.
corresponding to	
Metallic iron	59.09 per cent.

"SOUTHEASTERN TEXAS.

Sulphur	0.002 per cent.
Phosphorus	0.47 per cent.
Silica	8.62 per cent.
Oxide of iron	75.71 per cent.
corresponding to	
Metallic iron	53.00 per cent.

"CENTRAL TEXAS.

	No. 1.	No. 2.
Sulphur	0.008 per cent.	0.09 per cent.
Phosphorus	0.12 per cent.	0.22 per cent.
Silica	27.68 per cent.	8.85 per cent.
Oxide of iron	75.47 per cent.	85.52 per cent.
corresponding to		
Metallic iron	52.83 per cent.	59.67 per cent.

"NORTHEAST TEXAS.

	No. 1.	No. 2.
Sulphur	0.22 per cent.	0.23 per cent.
Phosphorus	0.04 per cent.	0.19 per cent.
Silica	1.87 per cent.	6.83 per cent.
Oxide of iron	87.69 per cent.	84.91 per cent.
corresponding to		
Metallic iron	61.38 per cent.	57.44 per cent.

"OCHRES.

"There are quite abundant deposits in the State of a kind of iron ores that are usually called ochres. They are characterized by being easily pulverized, soft to the touch, and freedom from grit, and by their containing considerable quantities of alumina. They find considerable use in the preparation of the so-called mineral paints, and are quite valuable for such and other purposes."

Analyses are given of ochres from Northwest Texas and Central Texas.

EVERHART, EDGAR.

The subject of Coal and Lignite is discussed. Two analyses of bituminous coal are given, one a sample recorded as from Llano county, the other from Palo Pinto county, near Gordon. Analyses of lignites from different parts of the State are tabulated: Robertson county; Cherokee county; Milam county; Hopkins county; Northwest Texas; North Texas (3); Burnet county (2). [See No. 7, Ashburner, Charles A. (Coal in Texas).]

Of mineral waters, the following analyses are given:

"CHALYBEATE WATER—FRANKLIN, TEXAS.

"One gallon of the water contains:

Sulphate of lime	20.965 grains.
Sulphate of iron	75.952 grains.
Sulphate of alumina	2.228 grains.
Sulphate of magnesia	13.063 grains.
Sulphate of soda	7.109 grains.
Sulphate of potash	0.752 grains.
Sulphate of ammonia	trace.
Chloride of sodium	9.715 grains.
Silica and insoluble matter	2.041 grains.
Total grains per gallon	131.825

The water has a slight acid reaction."

A second and third analysis of chalybeate water at Franklin are given.

"ALUM WATER—DENISON.

"One gallon of the water contains:

Sulphate of lime	30.652 grains.
Sulphate of alumina	26.850 grains.
Sulphate of iron	0.239 grains.
Sulphate of magnesia	3.312 grains.
Sulphate of potash	0.286 grains.
Chloride of sodium	4.222 grains.
Chloride of magnesium	0.140 grains.
Silica and insoluble matter	2.735 grains.
Total grains per gallon	68.436

"ALUM WATER—FRANKLIN.

"One gallon of the water contains:

Chloride of sodium	3.942 grains.
Sulphate of soda	0.898 grains.
Sulphate of potash	0.548 grains.
Sulphate of lime	6.217 grains.
Sulphate of magnesia	2.624 grains.
Sulphate of iron	5.651 grains.
Sulphate of alumina	30.005 grains.
Silica and insoluble matter	2.887 grains.
Total grains per gallon	52.772

EVERHART, EDGAR.

"ALKALINE SULPHATIC WATER—GEORGETOWN.

"One gallon of the water contains:

Chloride of sodium	58.720 grains.
Bicarbonate of soda	1.225 grains.
Carbonate of lime	23.414 grains.
Carbonate of iron	0.811 grains.
Sulphate of alumina and potash	8.363 grains.
Sulphate of potash	5.931 grains.
Sulphate of soda	201.197 grains.
Sulphate of magnesia	62.925 grains.
Sulphate of lime	17.548 grains.
Silica and insoluble matter	0.991 grains.
Total grains per gallon	381.125

"Free carbonic acid gas per gallon, 39.6 cu. in."

"SULPHUR WATER—LAMPASAS—'HANNA SPRING.'*

"One gallon of the water contains:

Hyposulphite of soda	0.775 grains.
Hydrosulphate of sodium	0.111 grains.
Chloride of sodium	555.869 grains.
Chloride of potassium	10.287 grains.
Chloride of magnesium	50.049 grains.
Chloride of calcium	48.905 grains.
Carbonate of lime	34.465 grains.
Sulphate of lime	0.951 grains.
Bromide of magnesium	trace.
Alumina	2.286 grains.
Silica and insoluble matter	1.673 grains.
Organic matter	trace.
Total grains per gallon	705.371

Free sulphuretted hydrogen gas, per gallon	5.82 cu. in.
Free carbonic acid gas, per gallon	11.80 cu. in.

The water has a faint acid reaction.

The temperature of the water in the spring is 70° F., and its specific gravity is 1.0074.

"SULPHUR WATER—LAMPASAS—'COOPER SPRING.'

"One gallon of the water contains:

Hyposulphite of soda	0.227 grains.
Hydrosulphate of sodium	0.827 grains.
Chloride of sodium	346.974 grains.
Chloride of potassium	3.586 grains.

*For analysis by E. Waller, Ph. D., see No. 66, Cummins' "The Southern Border of the Central Coal Field," First Ann. Rept. Geol. Surv. Texas, p. 172.

EVERHART, EDGAR.

Chloride of magnesium	21.857 grains.
Chloride of calcium	48.147 grains.
Sulphate of lime	4.461 grains.
Carbonate of lime	11.372 grains.
Bromide of magnesium	trace.
Alumina	3.540 grains.
Silica and insoluble matter	0.565 grains.
Organic matter	trace.
Total grains per gallon	441.556

Free sulphuretted hydrogen gas, per gallon.................... 2.07 cu. in.
Free carbonic acid gas, per gallon.............................45.11 cu. in.

"The water has a faint acid reaction. The temperature of the water in the spring is 70° F., and has a specific gravity of 1.007."

162. ——————

(Nacogdoches Oil.)

Geological and Scientific Bulletin, Vol. I, No. 4. Houston, August, 1888.

An extract from "Contributions from the Chemical Laboratory," University of Texas, Bulletin No. 4. See preceding title.

163. FONTAINE, WILLIAM MORRIS.

Notes on some Fossil Plants from the Trinity Division of the Comanche Series of Texas.

Proceedings of the U. S. National Museum, Vol. XVI, 1893, pp. 261-282, pls. xxxvi-xliii. Washington, 1894.

"The fossil plants whose description form the subject of this paper were collected by their discoverer, Mr. J. W. Harvey, of Glen Rose, Texas. They occur in the bed of the Paluxy River, two miles above Glen Rose. The material containing the fossils is a pretty firm limestone, quite free from sand and clay, and light gray in color, which was evidently a deposit formed at a considerable distance from the shore. This necessitated a prolonged immersion of the plant remains in water and their transportation over long distances. This conclusion, drawn from the nature of the sediment, is confirmed by the condition and character of the plant fossils. * * *

"Most of the fossils are in the form of small fragments. Cones of conifers and bits of twigs of the same much predominate. The twigs have usually thick leathery leaves and a dense durable epidermis. These facts indicate that the plants and parts of plants that can withstand long drifting are predominant, because more perishable forms were destroyed in transportation. Conifers of certain types are most common, probably because, under the existing conditions, they were best fitted for preservation, and not because they were most common in the flora." P. 261.

Subdivisions of the Lower Cretaceous according to Prof. R. T. Hill.

FONTAINE, WILLIAM MORRIS.

Description of the Species. Equisetaceae. *Equisetum texense*, sp. nov. Ferns. *Sphenopteris valdensis*, Heer? Cycads. *Dioonites Buchianus*, var. *rarinervis*, var. nov. *D. Buchianus*, Schimper. *D. Buchianus*, var. *angustifolius*, Font. *D. Dunkerianus*, (Gopp.) Miquel. *Podozamites acutifolius*, Font.? *Podozamites* species? *Zamites tenuinervis*, Font. Conifers. *Abietites Linkii*, (Roem.) Dunk. *Laricopsis longifolia*, Font. *Sphenolepidium Sternbergianum*, var. *densifolium*, Font. *Pinus* species? *Brachyphyllum texense*, sp. nov. *Pagiophyllum dubium*, sp. nov. *Frenelopis varians*, sp. nov. *F. Hoheneggeri* (Ett.) Schenk. *Sequoia pagiophylloides*, sp. nov. *Abietites* species? Plants of Uncertain Affinities. *Williamsonia texana*, sp. nov. *Carpolithus obovatus* sp. nov. *C. Harveyi* sp. nov. *Cycadeospermum rotundatum*, Font.

Age and Affinities of the Trinity Flora.

"The plants found at Glen Rose show, so far as can be judged from so imperfect a collection, that the Trinity flora finds its closest resemblance in the older portion of the lower Potomac. There is, however, this important difference: No trace of angiosperms, even the most archaic, has been found in the Texas region. We have only the four elements of the typical Jurassic flora. This then makes the Trinity flora somewhat older than that of the oldest Potomac. The absence of the angiosperms and the presence of the forms that are found indicate decidedly that the Trinity flora is not younger than the earliest stage of the Cretaceous. The number of plants found to be identical with certain of those of the oldest Potomac shows that there is little difference in the age of the two formations. The plant-bearing portion of the Trinity is somewhat older than the basal Potomac strata, but the difference in age cannot be great." Pp. 279-280.

164. G.

Sketch of the Natural Gas Field near Brenham, Texas.

Geological and Scientific Bulletin, Vol. I, No. 8. December, 1888.

"In the year 1879, Wm. Seidell, seeking water for farm purposes, had a well bored to a depth of between one hundred and fifty and one hundred and sixty feet, when a sand rock was reached, which produced a fine flow of natural gas. At that time natural gas was not as prominent as fuel, and no attention was paid to the find further than to use it as a plaything and for domestic uses in a tenant house near by. The Hon. J. E. Gray, of Brenham, Texas, a former representative of Washington county, and a gentleman of fine intelligence, who lived not far from this well, in a letter to J. B. Gilmer & Co., says of it:

" 'The well was bored in August, 1879, eleven inches in diameter, making eight inches after being curbed with wood. When burning, the flame would extend fully fifteen feet high. When the gas was confined, and allowed to escape through a small hole in the well covering, and a snuff bottle placed to it, the noise made by the stream of gas in the bottle resembled that of a steam whistle, and was plainly heard a mile or more from the well. The force or volume of the well did not perceptibly diminish until old sacks, used in extinguishing the flame, dirt, chunks of wood, etc., were

G.

dropped or thrown in the well. The gas continued to flow, and was utilized both for fuel and light in a small tenant house situated about thirty feet from the well, for about three years, when it was found that the well had been stopped up the distance of about twenty feet from the bottom.' After the flow of gas was thus cut off, no attention was paid to the matter until the winter of 1887-8, when J. B. Gilmer & Co., of Waco, leased the tract on which the land was, and many other tracts in the neighborhood, and commenced boring to see if the gas was still there. They attempted to bore out the old well, but found it so effectually stopped that it was cheaper to bore a new one. * * * When the first well put down for J. B. Gilmer & Co. reached the depth of the old well, the gas began to flow as when the old well was in its glory. The workmen were found to be incapable of properly casing a well, and out of a number dug in the spring of 1888, none were saved, as the clay caved and cut off the gas. This caused a suspension of work until October, 1888, when an experienced driller was secured.

"Since then three wells have been put down and secured. One is near the original well, 154 feet deep; one about three or four hundred yards to the southeast, 134 feet deep; the third about a half a mile to the northwest, about 114 feet deep. Measured by an anemometer, these three wells flow about a million and a half cubic feet of gas per day. Prof. J. P. Lesley, State Geologist of Pennsylvania, estimates that one pound of coal has a fuel capacity of 7½ cubic feet of gas. On this basis the fuel value of these wells amounts to 100 tons of coal per day. When the shallow depths of these wells through clay is considered, and the cheapness with which they can be made, their fuel value, compared with their cost, is enormous. This field is 10½ miles from Brenham, a city of seven thousand people, or about one thousand families. It offers a market, on an estimate by one of its most conservative citizens, of about $75,000 worth of gas per annum. This is as the city now stands, without any calculation for increase of wealth from growth of place. The wells are about 1½ miles from the Austin branch of the H. & T. C. R. R." * * *

165. GANNETT, HENRY.

A Dictionary of Altitudes in the United States. (Second Edition.)

Bull. of the U. S. Geol. Surv., No. 76, 393 pp. Washington, 1891.

The altitudes of the principal railroad stations in Texas are given, as well as of a number of other points. A valuable work of reference.

166. GENTH, F. A.

Contributions to Minerology, No. 44.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 198-203. New Haven, Sept., 1889.

"1. Gadolinite.—In the fall of the year 1888, Dr. A. E. Foote sent me for identification a shining black mineral which he brought from Burnet county, Texas. A preliminary examination, which I made, proved it to be *Gadolinite*, which, excepting that from Colorado, described and analyzed by

GENTH, F. A.

Mr. L. G. Eakins, of the U. S. Geol. Survey, had never been observed in this country. Since it became known that the mineral brought from Texas by Dr. Foote was gadolinite, large quantities have been obtained, some in crystals, weighing from seven to eleven pounds. I am indebted to Mr. W. Earl Hidden for some from Llano county, Texas, and give in the following the results of my analyses of this as well as that received from Dr. Foote.

"It has a black color; in thin splinters it is translucent with a dark bottle-green color; the fine powder is greenish-gray; fracture conchoidal to splintery. Sp. gr.=4.201 (Burnet county) to 4.254 (Llano county).

* * *

"The Texas gadolinite is altered into a brownish-red mineral of waxy lustre, finally into a reddish or yellowish-brown earthy substance. Neither could be obtained in a state of purity, but I will give below a partial analysis of the former. *Tengerite* (?) or yttrium carbonate in thin, white crystalline incrustations is found between the cracks of the gadolinite. There was only enough obtainable to show their composition by qualitative tests.

* * * * * * *

"The following results were obtained:

	I. BURNET COUNTY.		II. LLANO COUNTY.	
	a	*b*	*a*	*b*
$Si O_2$	22.87*)	23.40*)	22.80	22.92
$Al_2 O_3$	0.28	0.33	0.31	0.29
$Ce_2 O_3$ †)	2.65	2.76	2.66	2.85
$(Di, La)_2 O_3$	5 22	5 17	5.01	5.33
$(Y, Er)_2 O_3$	44.35	44.65	44.45	44.30
Mn O	0.22	not det.	0.18	not det.
Fe O	13.69*)	13.58	12.93	13.03
Be O	9.24	9.32	9.19	9.34
Mg O	0.07	0.08	0.11	not det.
Ca O	0.64	0.54	0.71	0.78.
$Na_2 O$	0.20	not det.	0.23	not det.
$K_2 O$	0.15	" "	0.12	" "
Ignition	0.72	" "	0.79	" "
Insoluble in dil. $H_2 S O_4$	not det.	" "	0.93	0.92
	100.30		100.42	

"* includes the Fe_2O_3 and SiO_2, insoluble in dilute sulphuric acid

"† Mr. L. G. Eakins informed me that he had found $Th O_2$ in the Texas gadolinite. As I had not tested for it, I examined the ceric oxide, left from the four analyses, and found it to contain 3.22 per cent. of $Th O_2$.

"DECOMPOSED GADOLINITE FROM LLANO COUNTY.

Spec. grav	3.592
Ignition	9.30
Quartz	1.03
$Si O_2$	22.11
$(Ce, Di, La, Y, Er)_2 O_3$	39.20
$Fe_2 O_3$	14.53
Be O	6.03
Mn O	0.22
Ca O	5.58"

167. GEOLOGICAL AND SCIENTIFIC BULLETIN.

Artesian Well Notes.

Vol. I, No. 7. Houston, Nov., 1888.

"Bosque and Somervell counties head the list of artesian wells, having between one and two hundred already flowing from depths of 100 to 600 feet. One well in Bosque county is on a hill top, 250 feet above the level of the surrounding creeks—is 800 feet deep, and yields a good flow of water.

"Two fine wells have been bored on one of the highest points around Waco, one of them about 1500 feet deep, with flowing water from both.

"The last well at Galveston promises to be the best of all dug up to the present in yield of water.

"The wells at Yorktown are shallower even than those at Houston. The water is found under a very impervious stratum of clay, which shows no evidence of moisture, even within three or four inches of the water bed."

168. ——————

Geological Survey of Texas.

Vol. I, No. 7. Houston, Nov., 1888.

An account of the field work of the Geological Survey, with special reference to the assignments and investigations of Messrs. Penrose, Owen, Tait, Jermy, Streeruwitz and Cummins.

169. ——————

Natural Gas.

Vol. I, No. 7. Houston, November, 1888.

"In the Greenview neighborhood, six miles from Burton, Messrs. Gilmer and Co., of Waco, have succeeded in obtaining two fine flows of natural gas from a depth of about 150 feet."

170. ——————

Geological Survey of Texas.

Vol. I, No. 8. Houston, December, 1888.

A brief summary of the various reports to be embraced in the forthcoming "First Report of Progress."

171. ——————

Geological Survey of Texas.

Vol. I, No. 11. Houston, March, 1889.

Reference to the routine work of the State Geologist; to the field work of Messrs. Penrose, Cummins, Streeruwitz, Jermy, Huppertz and Taff; and to the chemical analyses of Messrs. Herndon, Smith and Halley.

172. ——————

Geological Survey of Texas.

Vol. I, No. 12. Houston, April, 1889.

GEOLOGICAL AND SCIENTIFIC BULLETIN.

"The State Geologist, in company with Dr. Penrose, made a trip down the Colorado river from Austin to La Grange to secure as complete a section of the Tertiary formation as possible, and to determine the true sequence of the different beds already known to occur in it. The trip was made in a row boat, and required nearly six days for its completion. The results were highly satisfactory, and will go very far toward giving us a correct idea of the Tertiary history of the State. Lignites were found in abundance. Many fine beds of fossils were observed, and as full collections made as the time permitted. Near La Grange a fine deposit of palm impressions was found in a bed of sandstone, accompanied by pieces of the trunks and stems silicified. Among the fossils taken were those of the characteristic Eocene species of shells with shark teeth and corals."

Brief mention is made of the work of Messrs. Penrose, Streeruwitz, Cummins, Jermy, Taff, and Huppertz.

173. GILBERT, G. K.

Administrative Report.

Eleventh Ann. Rept. U. S. Geol. Survey, Part I, Geology. Washington, 1890.

(Work in Texas, pp. 58-59.)

"A study of the Cretaceous formations in Texas, begun some years ago by Mr. Robert T. Hill and temporarily discontinued, was resumed last summer as a joint work of the Geological Survey of Texas and the U. S. Geological Survey. The upper and lower boundaries of the system were traced and mapped from the Colorado river northward to the Red River, and the principal subdivisions also were outlined between the Brazos and Red rivers. The larger share of the expense of the recent work was borne by the State Survey, and it is arranged that the most comprehensive publication of the scientific results shall appear in the forthcoming first annual report of the State Geologist."

174. GOLDSMITH, E.

Gadolinite from Llano County, Texas.

Proc. Acad. of Nat. Sciences, Phila., Part II, pp. 164-165. May-Sept., 1889.

"The specimen so called which came from the above locality is in the Wm. M. Vaux collection of the Academy, and is of unusual size. It appears as a rough orthorhombic crystal. A piece broken off at one end revealed the fact that the crystal was not homogenous throughout. Within, a glassy material, surrounded by a rather thick layer of perfectly dull appearance, indicated that it was made up of at least two different minerals. I procured from the mineral dealer fragments of these two substances for investigation. The inner or vitreous substance proved to be Gadolinite. In mass the color is deep black and opaque, but when a thin plate is prepared by grinding, it appears green. Beneath the microscope apparently all is homogenous, only a few minute black spots are noticed. * * *

"Fracture conchoidal and uneven. Hardness=6. Sp. gr.=4.276. It

GOLDSMITH, E.

affords no streak on unglazed porcelain, and it is brittle; the powder is grayish green.

"For analysis the substance was selected with care, and was easily decomposed by hydrochloric acid, the silica gelatinizing.

"The result was as follows:

Silica	25.70 per cent.	O=13.7
Ittria	58.30 per cent.	O=12.
Iron monoxide	15.52 per cent.	O= 3.44
Glucina	2.10 per cent.	O= 1.32

* * * * * * *

"The material enveloping the Gadolinite seems to be amorphous; dull, with an uneven fracture and brittle; its color is grayish brown; streak red, when powdered bright red.

"It was found necessary to float off the suspended part in water from another portion which was not decomposable by hydrochloric acid, and this was repeated until a sample was wholly decomposable by that acid. The silica did not gelatinize.

"Hardness=3. Sp. gr.=3.494.

"Not fusible before the blow-pipe. The fluxes indicated iron; heated in a tube it gave water. Heated with carb. soda upon charcoal it afforded a dark-brown slag.

"The analysis indicated great complexity of mixture:

SiO_2	18.145 per cent.	O= 9.676
$Ce_3 O_4$	20.662 per cent.	O=16.773
$Fe_2 O_3$	26.026 per cent.	O= 7.807
Y O	21.854 per cent.	O= 4.500
Ca O	3.642 per cent.	O= 1.040
Mg O	0.214 per cent.	O= 0.085
H O	9.761 per cent.	O= 8.676

* * * * * * *

"I am not aware that this material over the Gadolinite has been named. I propose for it the name *Metagadolinite*."

175. GREGG, A.

Economic Minerals of San Saba County.

Texas Geol. and Min. Surv., First Rept. of Progress, 1888, pp. 74-76. Austin, 1889.

Economic Minerals of San Saba County. Marbles: Color and Varieties; Specimens furnished the U. S. National Museum. Great Springs: Artesian in Character; Valuable for Power and Irrigation; Occurrence along the Paleozoic Outcrop in the southern part of the County. Sandstone for Building Purposes abundant; of a "rich warm yellow" color; Colorado River cuts through an extensive deposit; some strata 12 feet thick. Grindstone Grit near the mouth of the San Saba, and at several points on the Colorado. Blue Limestone occurs near the town of San Saba. "Fire-proof" rock is abundant, underlying the Blue Limestone. White Limestone occurs between the San Saba river and the Paleozoic Outcrop. Paleozoic Rocks, Granite, Granite Sandstone, Quartz Schist, etc., GREGG, A.

occur in the southern part of the County. Pure white clean sand suitable for glass is found in the western part of the county. Coal found at Milburn (McCulloch County) and Vicinity.

"The so-called mineral belt extends through the southern third of the county, and in it have been found gold, silver, copper, lead, and manganese, but none of these minerals have as yet been mined with success." P. 76.

176. GULLIVER, F. P.

Cuspidate Forelands.

Bulletin Geol. Soc. Amer., Vol. VII, pp. 399-442. 1896.

Among the typical examples of "Overlap," that at Corpus Christi Pass, Texas, is mentioned.

177. HARRINGTON, H. H.

Alkali Soils.

Geological and Scientific Bulletin, Vol. I, No. 12. Houston, April, 1889.

"'Alkali soil,' as the term is commonly employed, has reference usually to the saline or alkaline matter present in the soil that exerts an injurious effect on vegetation. These salts may or may not be really alkaline in reaction. The term 'alkali soil' is, therefore, to a certain extent, indefinite and ambiguous, since the salts may consist of borates and carbonates of potash and soda, giving an alkaline reaction to test paper, viz.: Chlorides and sulphates of potash, soda and magnesia, phosphates of soda and lime, nitrates of soda and potash. It will be at once noticed that the latter class of compounds contains the three great elements of plant food—potash, phosphoric acid and nitrogen—those three elements which alone the agriculturist can afford to buy in a fertilizer, and upon which every commercial fertilizer depends for its value. I call special attention to this fact, because, when the alkaline soils of Western Texas are brought under cultivation, the practically inexhaustible quantity of some of these ingredients will be a matter of great economical importance, enabling the farmer, by a judicious use or renewing of organic matter in the soil, to possess a farm that will enrich both father and son.

"From a preliminary investigation of Pecos Valley soils, it seems that their alkalinity is due chiefly to alkaline carbonates of potash and soda and chlorides of the same elements. The first two salts are by far more injurious to plant growth, particularly blighting the young blades as they emerge from the ground. In some respects, however, their presence is not to be so much deprecated as is the presence of the chlorides, either alone or mixed with sulphates, since the alkaline carbonates, unless present in large quantity, may be decomposed by gypsum or sulphate of lime, converting the lime sulphate into the beneficial carbonate and the alkaline carbonates into the neutral sulphates. The chlorides, on the contrary, and some of the sulphates, it is necessary to remove by irrigation and drainage, unless, indeed, the quantity of rain were sufficient to carry these salts below the surface to an underground channel, or along the surface to

HARRINGTON, H. H.

streams that would remove the 'alkali' from the field—a condition of things not likely to soon take place in Western Texas. In case irrigation is applied, particular attention must be given to the character of water used. Obviously a stream carrying in solution a large quantity of saline matter could not be used with advantage, except under modified conditions, since the evaporation of the irrigation water would itself add largely to the already alkaline condition of the soil. When neither irrigation nor the use of gypsum is sufficient to reclaim an alkali soil, it is probable that chemical antidotes may be found that will prove efficient. For example, in certain cases lime might be used, although this or the use of any other chemical substance would depend upon the character of the alkali, a matter requiring special investigation and trial in each particular case."

* * * * * * *

178. ——————

A Preliminary Report on the Soils and Waters of the Upper Rio Grande and Pecos Valleys in Texas. (Appendix by E. T. Dumble.) Geol. Surv. of Texas, Bulletin No. 2, 26 pp. Austin, 1890.

Letter of Transmittal by E. T. Dumble, State Geologist. Introduction by E. T. Dumble. Letter by the Author containing acknowledgments, etc.

SOILS AND WATERS OF THE UPPER RIO GRANDE VALLEY IN TEXAS.

Contents: Soils; Adobe Soil, Chemical Analysis, Mechanical Analysis; Sandy Loam, Chemical Analyses, Mechanical Analysis; Chemical Analyses of Soils from Foothills around Sierra Blanca and Bordering the Rio Grande Valley. Alkali Spots: Soil Incrustation, Black Alkali, White Alkali, Reclaiming Alkali Spots. Sediments, River Sediments. Water Supply: Analysis of Mesa Well Water, Analysis of Rio Grande Water, Quantity of River Water, Water Reservoirs or Storage Tanks, Nature of Alkali in the Valley. Conclusions.

SOILS AND WATERS OF THE PECOS VALLEY.

"I present, in addition to the above report, analytical work by Mr. P. S. Tilson upon the Pecos Valley soils, and Analyses of Pecos river water." P. 19.

APPENDIX—E. T. DUMBLE. (SEE DUMBLE, E. T., IN THIS RECORD.)

Extract from "Soils and Waters of the Upper Rio Grande Valley," etc., pp. 7-8:

"The investigation into the character of the soils of the upper Rio Grande Valley as planned consisted of a personal examination of that part of El Paso county adjacent to the Rio Grande from El Paso to a line below the site of Fort Quitman, for the purpose of ascertaining the character of soils and of the water supply, with especial regard to their capacity and suitability for irrigation.

"The scope of country investigated is some eighty miles in length and from two to six miles in width, varying with the breadth of the valley. upon the Texas side of the Rio Grande, and having an average width of

HARRINGTON, H. H.

about three miles. For this entire length the valley is either traversed or skirted by the G. H. & S. A. R. R. and the T. & P. R. R., these railways using the same track from El Paso to Sierra Blanco, ninety miles southeast. For about thirty miles below El Paso the greater part of the valley is now under cultivation. In many instances the orchard and vineyards are brought up to the highest state of perfection, rivaling in beauty and value those of the Pacific Slope.

* * * * * * *

"*Soils.*—The soils of the valley may in a general way be divided into three classes:

"First—The heavy 'adobe' soil of the river deposit.

"Second—The sandy loam, being an intimate mixture of the adobe soil with the sand of the foothills adjacent to the valley.

"Third—The sandy soil, containing an excess of the sand from the foothills.

"The adobe soil is most difficult to cultivate, is plastic, and is generally supposed to contain a larger amount of alkalies than either of the other soils. The sandy soil is regarded as the best adapted for vegetables and alfalfa, while the sandy loam, which is the predominating soil, is used for various crops."

178a. ——————

Texas Soils: A Study of Chemical Composition.

Bulletin No. 25, Texas Agricultural Experiment Station. Bryan, 1892.

Discussion of the practical benefit of soil analysis to the farmer. Directions for collecting samples. Classifications: Soils of the State of six different types. 1st—The Coast Belt. 2nd—The East Texas Belt. 3rd—The Black Prairie Belt. 4th—The Ft. Worth Prairie Belt. 5th—The Panhandle Soils. 6th—The Alluvial Soils.

The Coast Belt. Analyses of Soils: No. I, from Rusk, Cherokee Co.; No. II, from Colmesneil, Tyler Co.

ELEMENTS.	No. I.		No. II.	
	Surface	Subsoil.	Surface	Subsoil.
Moisture	0.8	0.4	0.37	0.3
Volatile and organic matter	2.05	0.73	1.18	0.67
Insoluble matter and sand	96.212	97.764	97.584	98.168
Iron oxide	0.776	0 931	} 0.75	0.78
Alumina oxide	Trace	0.009		
Calcium oxide	Trace	Trace	....	....
Magnesium oxide	Trace	Trace	0.079	....
Sulphuric acid	Trace	Trace	Trace	Trace
Phosphoric acid	Trace	Trace	Trace	Trace
Potash	Trace	Trace	Trace	Trace
Soda	Trace	Trace	Trace	Trace
Carbonic acid	Trace	Trace	....	....

Analyses: No. I, Creek Bottom Land, Tyler Co.; No. II, Valley Land, Cherokee Co.

Harrington, H. H.

ELEMENTS.	No. I.		No. II.	
	Surface	Subsoil.	Surface	Subsoil.
Moisture	2.30	1.77	1.32	1.02
Volatile and organic matter	3.22	2.56	4.60	3.31
Insoluble matter and sand	89.49	91.09	83.22	85.91
Iron oxide	3.94	4.12	5.82	6.44
Alumina oxide			2.12	1.70
Calcium oxide	0.44	0.36	0.555	0.255
Magnesium oxide	0.08	0.15	0.126	0.197
Sulphuric acid	Trace	Trace	....	....
Phosphoric acid	0.03	0.03	0.243	0.141
Potash	0.06	0.12	0.48	0.44
Soda	0.07	0.16	0.40	0.49
Carbon Dioxide	....	....	0.44	0.187

"Both of these samples represent the better types of soil in the East Texas belt of soils, and while the analysis cannot compare with that of the richer lands in the State, it is very favorable, indeed."

* * * * * * *

"*The Black Prairie Belt.*—There are four divisions of this with only slight variations: The first on the east, next to the timber belt, is distinguished by the presence of sand in the soil—with occasional pure beds of sand—illustrated by the analysis of soil samples from Terrell and Pecan Gap. West of this strip comes the main black waxy area—characterized by a substructure of light blue or yellow calcareous clay, called by residents 'soap stone' and 'joint clay,' from its laminated structure. Small depressions in the surface of the soil, called 'hog-wallows,' are quite common. These are caused by the unequal drying and expansion of the calcareous clays in poorly drained places. Greenville, Terrell, Kaufman and Corsicana are situated near the dividing line between the above two divisions. Below will be found analyses of samples from Terrell, Pecan Gap, Forney, Belton and Manor—the three latter soils illustrating the main black waxy belt.

HARRINGTON, H. H.

LOCALITY.	Water.	Volatile and organic matter.	Insoluble matter and sand.	Iron oxide.	Alumina oxide.	Calcium oxide.	Magnesium oxide.	Sulphuric acid.	Phosphoric acid.	Potash.	Sodium.	Carbon dioxide.
Terrell.												
Surface	2.09	6.84	85.96	1.08	1.68	0.55	0.28	0.24	0.28	0.17	.07	....
Subsoil	2.09	3.81	87.95	1.45	2.71	0.37	0.32	0.11	0.23	0.13	.14	....
Pecan Gap.												
Surface	6.34	7.88	68.06	4.23	9.48	.814	.32	.24	.13	.83	.64	.344
Subsoil	7.57	6.67	62.91	4.19	10.37	3.05	.34	.12	.18	1.29	.60	2.32
Forney.												
Timber Land.												
Surface	4.56	6.03	60.55	2.42	4.53	11.00	.543	.127	.326	.316	1.28	8.49
Subsoil	4.36	7.42	60.96	2.27	5.59	10.05	.64	.16	2.66	.419	1.85	7.78
Prairie Soil.												
Surface	7.57	11.06	56.5	2.82	7.04	6.62	.81	.151	.313	.837	.052	6.26
Subsoil	6.78	10.96	56.4	2.78	2.38	7.35	.615	.137	.294	.606	.109	6.06
Hammock.												
Surface	7.91	6.92	62.98	2.86	7.35	6.30	.46	.147	.25	.68	.09	4.91
Subsoil	7.70	6.16	62.84	2.74	8.18	6.74	.297	.216	.499	.39	.25	4.48
Manor, Travis County.												
Surface	8.47	7.26	50.69	3.73	16.35	5.81	.317	.082	.115	.576	.151	5.84
Subsoil	3.27	7.18	51.17	4.74	14.33	6.96	.507	.147	.179	.604	.095	6.11
Belton, Bell County.												
Black Waxy.												
Surface	2.42	7.34	44.23	(1.58)		23.98	.94	.15	.12	.22	.25	18.00
Subsoil	1.94	2.65	48.17	(2.68)		23.6	1.13	.21	.13	.28	.30	18.35
Belton, Bell County.												
Hammock.												
Surface	3.56	6.52	77.05	2.66	4.91	1.03	.73	.02	.18	1.45	.93	.81
Subsoil	4.91	2.51	78.09	3.98	7.74	0.83	.9	.02	.17	1.07	.33	.65

"The next division of the black prairie belt lies to the west of the 'black waxy' proper. It is a narrow strip, only about two miles wide; and reaching from Red river to the Rio Grande. Its surface is characterized by an outcrop of 'white rock,' or chalky country. Some of the most prosperous towns of the State are situated upon this narrow belt: Paris, Sherman, McKinney, Dallas, Waxahachie, Waco, Austin, New Braunfels and San Antonio.

* * * * * * *

"Analysis of samples from Waxahachie and New Braunfels. No. I, Waxahachie; No. II, New Braunfels:

ELEMENTS.	No. I.		No. II.	
	Surface	Subsoil.	Surface	Subsoil.
Moisture	9.06	7.64	7.22	7.34
Volatile and Organic Matter	7.77	5.80	4.96	2.24
Insoluble Matter and Sand	59.9	53.17	61.99	51.07
Oxide of Iron	5.44	5.18	4.03	4.15
Oxide of Alumina	6.81	6.32	5.62	5.76
Oxide of Calcium (Lime)	5.17	10.62	7.32	14.66
Oxide of Magnesia	.67	1.41	1.31	.96
Sulphuric Acid	.14	.29	.30	.17
Phosphoric Acid	.15	.65	.41	.57
Potash	.35	.41	.22	.47
Soda	.04	.24	.13	.12
Carbon Dioxide	3.98	8.11	5.8	11.52

HARRINGTON, H. H.

PANHANDLE AND ALLUVIAL SOILS.

LOCALITY.	Water.	Volatile and organic matter.	Insoluble matter and sand.	Iron oxide.	Alumina oxide.	Calcium oxide.	Magnesium oxide.	Sulphuric acid.	Phosphoric acid.	Potash.	Sodium.	Carbon dioxide.
Panhandle—Abilene.												
Black Loam.												
Surface	4.52	3.05	73.78	1.78	6.51	4.04	1.4	.154	Trace	1.137	.957	2.25
Subsoil	4.80	2.69	64.3	2 23	5.05	9.32	1.09	4.22	.102	.588	.305	5.20
Wichita.												
Chocolate Loam.												
Surface	1.62	3.01	88.46	2.06	3.82	.074	Trace	.058	Trace	.426	.139	......
Subsoil.*												
El Paso County Soils:												
No. I, Red sandy	......	8.33	78.63	7.44	2.22	.57	....	.38	.34	.52	.46	Tr'ce
No. II, Sandy loam	......	7.65	74.85	4.08	3.84	3.83	Trace	.73	.60	.43	.85	2.13
Alluvial--Fort Bend County.												
Sandy Loam.†												
Surface	1.17	1.54	84.31	2.36	3.87	2.74	.24	Trace	.166	.46	.37	2.24
Subsoil	2.26	2.91	79.5	2.91	5.87	2.01	.23	Trace	.26	1.24	1.25	1.58
Brazoria County.												
Chocolate Loam.												
Surface	3.04	3.09	78.59	2.80	6.05	1.66	.126	Trace	.136	1.09	.856	2.04
Subsoil	3.28	2.50	77.57	3.18	8.28	1.82	.18	Trace	.128	.841	.443	1.71
Brazoria County.												
River Deposit	3.26	2.69	70.92	3.62	5.58	5.66	1.85	.29	.34	.885	.224	4.00
Brazoria County.												
Peach Ridge.												
Surface	4.62	9.39	76.45	2.60	3.51	.609	.73	.079	Trace	.545	.32	.34
Subsoil	3.11	4.70	82.79	2.33	4.73	.424	.368	.134	.154	.482	.262	.28

* Of same character as surface. † From State Sugar Farm.

Under the caption of "Miscellaneous Soils," the question of Alkali Soils is briefly discussed. Analyses are given of Black Alkali from Ysleta, and of a sample from the Rio Grande Valley, ten miles south of Fort Hancock. Analysis of "White Alkali." Analysis of Sample from Laredo. Reclaiming Alkali Spots. Analysis of Phosphate Rock (?) from Corpus Christi. Analysis of Clay from the College Farm.

"Of the work here reported, samples from the State Farm, Brazos bottom deposit from the river, College Clay, Forney, Kaufman county, hammock soil from Bell county, upland soil from Colmesneil, Wichita and Abilene soils, Manor soil, Pine Ridge and valley soils from Rusk, Pecan Gap soil, and phosphate rock were analyzed by Associate Prof. Duncan Adriance. Assistant Prof. P. S. Tilson analyzed samples of black waxy from Bell county, Brazos river deposit, creek bottom soils from Tyler county, Waxahachie soil, Terrell, New Braunfels, two soils from Cherokee county, and 'alkali' soils reported."

179. HARRIS, GILBERT D. (and DUMBLE, E. T.)

See Dumble and Harris.

The Galveston Deep Well.

Amer. Jour. of Science, III, Vol. XLVI, pp. 38-42. New Haven, July, 1893.

180. HARRIS, GILBERT D.

Correlation of Téjon Deposits with Eocene stages of the Gulf Slope.

(Correspondence.)

Science, Vol. XXII, p. 97. N. Y., Aug. 18, 1893.

"While comparing the Texan Eocene fossils with type specimens and others in the collection of the U. S. National Museum, and in the Philadelphia Academy of Natural Sciences, I have been impressed with the remarkable sameness in faunal characters throughout the vast extent of the lower Claiborne, or Lisbon, horizon; many of the species from South Carolina are identical with those from the banks of the Rio Grande, and the rocks from Ft. Téjon, California, furnish a very similar fauna with several identical and many more analagous species. Gabb's *Cardita hornii* is *Venericardia planicosta* Lam. as held by Conrad; the type specimen is slightly malformed and imperfect, but others from the same locality are quite typical *planicosta*. Gabb's *Architectonica cognata* is Conrad's *Solarium alveatum;* Gabb's *Architectonica hornii*, Conrad's *Solarium amoenum;* Gabb's *Neverita secta*, Conrad's *Natica œtites*, and so on. Gabb's peculiar and characteristic little *Whitneya ficus* is known from Alum Creek Bluff, Colorado River, Bastrop county, Texas, and is in itself a strong argument for the synchrony of the Texan and California beds from which it is derived. Moreover, in deposits of this horizon on both sides of the Rockies, there are similar developments in the genera *Crassatella, Cytherea, Pyrula, Levifusus, Rimella* and others.

"With the above facts in mind, I cannot help suggesting that those who have an opportunity to study the Eocene series of California (Téjon deposits) would do well to look for the Midway stage which ranks second in persistency among the subdivisions of the Eocene along the Gulf slope. In other words, search should be made along the Chico-Téjon contact for such species as *Enclimatoceras ulrichi, Cucullæa macrodonta, Ostrea pulaskensis*, together with varieties of *Venericardia planicosta, Turritella mortoni, T. humerosa*, and other Midway forms."

181. ————

Preliminary Report on the Organic Remains obtained from Deep Well at Galveston, together with Conclusions respecting the Age of the various Formations penetrated.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 117-119. Sheet showing the Bathymetric Distribution of the Fossil Shells. Austin, 1893.

"In the following brief report no attempt is made to give a detailed account of the organic remains derived from this well. Many of the forms are new and peculiar, and must be carefully studied, described and figured before their introduction into paleontological literature. Many of the well known forms present varietal characters worthy of minute study and description. Accordingly, the following pages are devoted to the results of a study into the relationships existing between the fossils obtained from the well and the recent faunæ of the Atlantic and Pacific shores of

HARRIS, GILBERT D.

America and the fossil faunæ of the Atlantic slope, including also that of the West Indies." P. 117.

The conclusions respecting the age of the formations penetrated are briefly as follows:

"Depth in feet.	Geological Horizon.
46 to 458	Pleistocene.
458 to 1,510	Doubtful.
1,510 to 2,158	Upper Tertiary.
2,158 to 2,920	Miocene (Upper)."

182. ——————

The Tertiary Geology of Southern Arkansas.

Ann. Rept. of the Geological Survey of Ark. for 1892, Vol. II. Morrillton, 1894.

(The Occurrence of the Midway Stage in Texas), pp. 33-34.

"Texas, Station 2440,—The occurrence of the Midway stage in Texas is confirmed by a few molluscan remains recently brought from Kaufman and Travis counties by Mr. T. W. Stanton. Four miles northeast of Kemp, in the former county, this horizon is represented by light gray and yellowish calcareous sandstone containing *Cucullæa macrodonta* (in great abundance), *Cytherea, Venericardia planicosta, Turritella mortoni, Natica alabamiensis.*

"Near Webberville, Travis county, on the Colorado river below Austin (Station 2439), Mr. Stanton found a clayey limestone more or less streaked with brown and yellowish shades, but usually of a light yellowish-gray hue. Chocolate colored siliceous pebbles, generally cuboidal in form, are often found in the more clayey beds. The enclosed shells, nearly always crystalline, are *Cucullæa macrodonta, Leda, Venericardia, Venericardia planicosta, Crassatella* (large) *Lithodomus, Volutilithes?* Coral, Shark's teeth.

"Station 583 (18 miles southeast of Eagle Pass, Texas, first night's camp, October 25, 1887.—C. A. White). The fossils collected here by Dr. White are *Cucullæa macrodonta, Pectunculus, Venericardia, Cardium.*

"The shelly matter of these species is completely crystallized.

"The matrix was evidently a calcareous light sand or sandstone.

"This place is far to the north of Laredo, where Claiborne fossils are found. Much doubt is felt regarding the Tertiary affinities of some of the fossils, although they were turned over to the writer from the Mesozoic division of the U. S. Geological Survey as non-Cretaceous forms."

See also p. 42 of this report.

183. ——————

New and Otherwise Interesting Mollusca from Texas.

Proc. Acad. of Nat. Sciences, Phila., Pt. I, pp. 45-88; pl. i-ix. Jan.-Mar., 1895.

"While employed as Tertiary Paleontologist to the Geological Survey of Texas during the years 1892 and 1893, the writer prepared a large mono-

HARRIS, GILBERT D.

graph on the Tertiary mollusca of the State, with the intention of publishing it in the 5th Annual Report of that Survey. For want of funds the printing of this report has been indefinitely postponed, and accordingly the following facts and descriptions of new species, taken from the monograph in question, have here found an appropriate place for publication.

"The points in stratigraphy brought out by the study of the various Tertiary faunas of the State have been included with other matter in an article published by the State Geologist in the Journal of Geology, 1894, p. 549. (See Dumble, E. T.)

"Suffice it to say here that the Midway stage, so well developed in Georgia and Alabama, and known also in Mississippi and Arkansas, exists also in Texas, as is proved by the occurrence of such species as *Enclimatoceras ulrichi, Ostrea pulaskensis, Cucullæa macrodonta, Volutilithes limopsis* and others.

"The Lignitic stage, so far as has been observed, is destitute of molluscan remains. The exposure on Brazos river, known as 'Smiley's Bluff,' two miles above the mouth of Pond creek, is evidently about synchronous with the Matthews Landing beds of Alabama. These are now included in the Midway stage.

"The Lower Claiborne beds are replete with fossils, many of which are common to this horizon in Louisiana, Mississippi, Alabama, and South Carolina. Besides these well-known forms there are many new ones, some of which are described below.

"The true Claiborne, the Jackson, and the Vicksburg stages seem to have no representatives in Texas. This fact cannot be too strongly emphasized since most writers on Texas geology have referred certain fossil bearing outcrops to some of these upper Eocene stages."

Of the Pelecypoda sixteen new species and one variety are described; of the Gastropoda, fifty-four new species and eleven varieties, with locality notes.

Listed, the fossils are as follows:

Pelecypoda. Genus *Modiola: M. houstonia* n. sp., *M. texana*, Gabb. Genus *Leda: L. bastropensis* n. sp., *L. milamensis* n. sp., *L. houstonia* n. sp. Subgenus *Adrana: A. aldrichiana* n. sp. Genus *Venericardia: V. trapaquara* n. sp. Genus *Astarte: A. smithvillensis* n. sp. Genus *Crassatella: C. texalta* n. sp., *C. trapaquara* n. sp., *C. antestriata* Gabb, *C. texana* Heilp. Genus *Sphærella: S.* (?) *anteproducta* n. sp. Genus *Meretrix: M. texacola* n. sp. Genus *Tellina: T. tallicheti* n. sp. Genus *Siliqua: S. simondsi.* Genus *Ceronia: C. singleyi* n. sp. Genus *Periploma: P. collardi.* Genus *Corbula: C. aldrichi*, Meyer, var. *smithvillensis* n. var. Genus *Martesia: M. texana* n. sp.

Gastropoda. Genus *Ringicula: R. trapaquara* n. sp. Genus *Volvula: V? smithvillensis* n. sp. Genus *Cylichnella: C. atysopsis* n. sp. Genus *Terebra: T. texagyra* n. sp., *T. houstonia* n. sp. Genus *Conus: C. smithvillensis* n. sp. Genus *Pleurotoma: Pl. enstricrina* n. sp., *Pl.* (*Pleurotomella*) *anacona* n. sp., *Pl.* (*Surcula*) *gabbi* Con., *Pl.* (*Surcula*) *moorei* Gabb, *Pl. beadata* n. sp., *Pl. vaughani* n. sp., *Pl. huppertzi* n. sp., *Pl. huppertzi* var. *penrosei* n. var., *Pl. leoncola* n. sp., *Pl.* (*Drillia*) *dumblei* n. sp.,

HARRIS, GILBERT D.

Pl. (*Drillia*) *dipta* n. sp., *Pl.* (*Drillia*) *nodocarinata* Gabb, *Pl.* (*Drillia*) *prosseri* n. sp., *Pl.* (*Drillia*) *Kellogi* Gabb, *Pl.* (*Drillia*) *texacona nom. mut.*, *Pl.* (*Drillia*) *texanopsis* n. sp., *Pleurotoma insignifica* Heilp., *Pl.* (*Mangilia*) *infans* Mr., *Pl.* (*Borsonia*) *plenta* n. sp. (by Ald. and Har.), *Pl.* (*Eucheilodon*) *reticulatoides* n. sp., *Pl.* (*Taranis*) *finexa* n. sp., *Pl.* (*Clathurella?*) *fannæ* n. sp., *Pl.* (*Bela*) *rebeccae* n. sp. Genus *Cancellaria*: *C. panones* n. sp., *C. panones* var. *smithvillensis* n. var., *C. panones* var. *junipera* n. var., *C. penrosei* n. sp., *C. bastropensis* n. sp., *C. ulmula* n. sp., *C. ellapsá* Con. Genus *Volvaria*: *V. gabbiana* n. sp. Genus *Volutilithes*: *V. dalli* n. sp. Genus *Caricella*: *C. demissa* Con., var. *texana* Gabb, *C. subangulata* Conrad, var. *cherokeensis* n. var. Genus *Turricula*: *T.* (*Conomitra*) *texana* n. sp. Genus *Levifusus*: *L. trabeatoides* n. sp. Genus *Latirus*: *L. singleyi* n. sp. Genus *Strepsidura*: *S. ficus* Gabb. Genus *Fusus*: *F. bastropensis* n. sp., *F. ostrarupis* n. sp., *F. mortoni*, var. *mortoniopsis* Gabb, *F. mortoni* Lea, var. *carexus* n. var. Genus *Clavilithes*: *C. regexus* n. sp., *C. humerosus* Conrad, var. *texanus* n. var., *C. kennedyanus* n. sp., *C.* (*Papillina*) *dumosus* Con., var., *trapaquarus* n. var., Genus *Chrysodomus*: *C. parbrazana* n. sp. Genus *Astyris*: *A. bastropensis* n. sp. Genus *Murex*: *M. fusates* n. sp. Subgenus *Odontopolys*: *M.* (*Odontopolys*) *compsorhytis* Gabb. Genus *Pseudoliva*: *P. ostrarupis* n. sp., *P. ostrarupis*, var. *pauper* n. var. Genus *Tenuiscala*: *T. trapaquara* n. sp., *T. trapaquara*, var. *engona* n. var. Genus *Pyramidella*: *P. bastropensis* n. sp. Genus *Syrnola*: *S. trapaquara* n. sp. Genus *Pyrula*: *P.* (*Fusoficula*) *texana* n. sp. Genus *Cypræa*: *C. kennedyi* n. sp. Genus *Rimella*: *R. texana* n. sp., *R. texana*, var. *plana* n. var. Genus *Cerithium*: *C. Webbi* n. sp., *C. penrosei* n. sp. Genus *Mesalia*: *M. claibornensis* Con. (MS). Genus *Turritella*: *T. nasuta* Gabb, var. *houstonia* n. var., *T. dumblei* n. sp., *T. dutexata* n. sp., *T. nerinexa* n. sp. Genus *Solarium*: *S. huppertzi* n. sp., *S. bastropensis* n. sp. Genus *Amauropsis*: *A. singleyi* n. sp. Genus *Dillwynella*. *D? texana* n. sp. Genus *Gaza*: *G? aldrichiana* n. sp.

184. ———————

Tertiary Paleontology of Texas.

Received at Cornell University, Ithaca, N. Y., April 11, 1895.

The preceding paper was also distributed in covers bearing the title here given.

185. ———————

Neocene Mollusca of Texas, or Fossils from the Deep Well at Galveston.

Bulletins of American Paleontology, Vol. I, No. 3, 32 pp.; 4 pl. Ithaca, N. Y., Dec. 2, 1895.

"In a recent article by the present writer, published in the Philadelphia Academy's Proceedings, reference is made to a monograph on the Tertiary Mollusca of Texas, which, owing to the lack of funds at the disposal of the State Geological Survey, had remained for some time unpublished.

HARRIS, GILBERT D.

"That the reader may have a clear idea as to what part of that monograph the Academy published, and what part we propose to bring out in this Bulletin, a summary of its contents is here given just as it was when completed, December 23, 1893.

"MONOGRAPH OF THE MARINE TERTIARY MOLLUSCA OF TEXAS.

"By Gilbert Denison Harris.

"*Preliminary Remarks*, pp. 1-5 (all pages are type-written).

PART 1. Brief review of the literature of the Tertiary mollusca of Texas, pp. 6-21.

PART 2. Eocene mollusca of Texas, pp. 22-352.—The name, author, synonomy, original description, additional remarks, all known localities for each species in Texas, important localities in other States, geological range, and where the type specimen may now be found.

Addenda to Part 2. New or interesting Eocene mollusca from other States, pp. 353-357.

PART 3. Neocene mollusca of Texas, or Fossils from the Galveston deep well, pp. 358-397.—The name, etc., as in Part 2, and the range in depth of each species.

PART 4. Definition and correlation of the marine Tertiary deposits of Texas, pp. 398-409.—Section 1. Review of the works and opinions of earlier writers.—Sec. 2. Conclusions drawn from the present paleontological study.

"The last mentioned part is followed by (1) a detail account of all the localities or stations whence the Tertiary fossils were obtained, (2) a table showing at a glance the geographical distribution of the Eocene molluscan species in Texas and their geological range in this State and others farther east, (3) a table showing the bathymetric distribution of the Galveston well fossils, pp. 410-434, and (4) 36 large octavo plates illustrating the species mentioned or described in Parts 2 and 3.

"The article published by the Academy contained the description of the new species of Part 2 and the figures belonging thereto; the majority of that part, and which alone is of present stratigraphic value, still remains in manuscript.

"This Bulletin is practically a condensation of Part 3. It seems advisable that this unique material should no longer remain unpublished, for up to this date no other marine Neocene fossils are known from the Gulf slope west of Mississippi. The opinions expressed, regarding the age of the deposits penetrated, in the American Journal of Science. Vol. 46, p. 42, and in the 4th Annual Report of the State Survey, 1893. are still maintained. * * * ." (See Title No. 181.)

A list of species belonging to the Pelecypoda, Scaphopoda and Gastropoda, with characterization, and range in depth follows.

186. ——————

The Midway Stage.

Bulletins Am. Paleontology, Vol. I, No. 4, 156 pp; 15 pls. Ithaca, N. Y., 1896.

HARRIS, GILBERT D.

Summary of Contents: Preliminary Considerations. Divisions of the Eocene. Aim and scope of this work. Collections of fossils, field notes, etc., on which this work is based: The Cornell University collection and the collectors' notes; Dr. J. M. Safford's collection of types; T. H. Aldrich's fossils and figures; Collection of the U. S. National Museum; The author's publications and notes on this stage in Arkansas and Texas.

Part I. Geology. Brief Historical Sketch of the Study of the Midway Stage. Period of 1834-1859: Featherstonhaugh, A. Winchell, Harper. Period of 1860-1883: Gabb, Safford, Hilgard, Loughridge, White. Period of 1884-1896: Johnson, Smith, Penrose, Langdon, Spencer, Safford, Harris, Aldrich.

Stratigraphic Nomenclature. Synonymy. Usage of the term Midway: Priority; Location, geographically and geologically; Differentiation from the Lignitic; The Midway Stage, a stratigraphic and paleontologic unit. Geology of the Midway Stage in Different States—Texas: Rio Grande section, Colorado river section, Brazos river section; Falls county, Limestone county, Kaufman county. Arkansas: Hot Springs county, Pulaski county, Lonoke county, Jackson and Independence counties. Tennessee: Crainesville and vicinity, Middleton and vicinity. Mississippi: Walnut and vicinity, Ripley and vicinity, Pontotoc and vicinity. Alabama: Black Bluff section, Naheola, Prairie Bluff and vicinity, Midway, Matthews' Landing, Snow Hill and vicinity, Allenton and Oak Hill and vicinity, Troy and vicinity, Clayton and vicinity. Georgia: Ft. Gaines and vicinity.

Additional remarks and Deductions—Nonconformability: Texas, Arkansas, Tennessee, Mississippi, Alabama, Georgia, Correlations made. Variation of faunas.

Part II. Paleontology. Description of the Molluscan Remains of the Midway Stage. Pelecypoda, Scaphopoda, Gastropoda, Cephalopoda, Plates and Explanations.

"*The author's works and field notes on this stage in Arkansas and Texas.* —The results of the author's work on this terrane in Arkansas and Texas are embodied in Vol. II of the Ann'l Rept. Geol. State Survey of 1892. The Midway and other Tertiary molluscan remains of Texas were fully described and figured in a large monograph prepared to accompany the Fifth Annual Report of the State Survey; but appropriations failed and the work remains unpublished as a whole; the new species were brought out in 1895 by the Philadelphia Academy of Natural Sciences in the 'Proceedings.' A few field notes and many paleontological facts are published for the first time in the present work." P. 6.

187. HARROD, B. M.

Archæan Rocks in Texas.*

New Orleans Acad. Sci. Papers, Vol. I, No. 2, pp. 131-133. 1888.

"Brief reference to outcrops and characteristics." From Darton's Record of N. A. Geol. Bull. U. S. Geol. Survey, No. 75, p. 83.

188. HAY, ROBERT.

Final Geological Reports of the Artesian and Underflow Investigation between the Ninety-seventh Meridian of Longitude and the Foothills of the Rocky Mountains to the Secretary of Agriculture.

Part III, of Senate Executive Document No. 41, of the 1st Session of the 52d Congress. Washington, 1892.

Letter of Transmittal. Contents: General Report, Plan of Work. Geology of the Plains: Water-holding Rocks; Reconnaissances in Montana and Wyoming. Topography of the Plains: Increment of Elevation Westward; Rivers separated into two Classes as to their Source, Mountain Rivers and Plain Rivers; Western Escarpment of the Plains. Water Supply of the Plains: Rivers of the Plains; Origin of their Waters; Special Description of the Smoky-Republican Region; Wells in the Interfluvial Spaces; Measured Flow of some of the Rivers of North Dakota: Classification of Artesian Wells by Depth and Pressure; The Red River Region, its Low Altitude and Smooth Contour; Character of the Water in the Wells; Extension of Artesian Areas discussed; Geology of the Glaciated Area; The Turtle Mountains; Variation of Lake Levels. The Underflow: Common use of the Terms in the West; The Facts of the Underflow; Restriction of the Term to its proper Range. Artesian Wells; Increased Number of Wells in the Principal Basins; Sources of Supply of the Dakota Main Basin; General Conditions of Artesian Flow; Other Causes of Flow besides Hydrostatic Pressure.

Reference is made to Texas under "The Underflow" and "Artesian Wells."

189. ——————

The Artesian Underflow Investigation.

Correspondence.

Amer. Geologist, Vol. XI, pp. 278-279. Minneapolis, Apr., 1893.

The reply to a criticism (Amer. Geol., Vol. XI, p. 113) of the "Final Geological Report[s] of the Artesian and Underground [Underflow] investigation, between the Ninety-seventh Meridian of Longitude and the Foothills of the Rocky Mountains to the Secretary of Agriculture. Made by Prof. Robt. Hay, F. G. S. A., Part Third, Washington, 1892."

190. HEILPRIN, ANGELO.

The Eocene Mollusca of the State of Texas.

Proceedings Acad. Nat. Sciences, Phila., Pt. III, pp. 393-406; plate xi. Oct.-Dec., 1890.

"The following list embraces, so far as I know, all the Eocene Mollusca that have thus far been noted to occur in the Gulf deposits of the State of Texas. For my data I have used the type series of Gabb and Conrad, the major portion of which is in the possession of the Academy of Natural Sciences of Philadelphia, the extensive collection of the State Geological Survey, and minor collections which have from time to time reached the Academy and been reported upon in its publications. The collections of

Heilprin, Angelo.

the State Geological Survey (for the use of which I am indebted to the Director, Mr. E. T. Dumble, and to Dr. R. A. F. Penrose, Jr., the geologist of the Tertiary areas of the State) are by far the most extensive, and they serve to definitely locate the formations whence the fossils were obtained in their true position in the geological scale. Of some 145 species here enumerated (including a few doubtfully determined forms) about 61 (or upwards of 40 per cent.) are also members of the Claiborne fauna of Alabama; these I have indicated by prefixing an asterisk. A few others occur in some of the older deposits of Alabama, while a very few are members of the Mississippi (newer) fauna. The recurrence of a large number of the species in various counties and localities indicates that the horizon is a common one, namely: the Clairbornian, or typical Middle Eocene of the Gulf slope, the equivalent of the Calcaire Grossier of the Paris Basin.

"The principal localities whence the fossils were obtained are Cherokee county, near Alto and McBee's School; Palestine, in Anderson county; Robertson county, near Wheelock; Milam Bluff in Milam county; Burleson Shell Bluff in Burleson county; Smithville, Devil's Eye, Bombshell Bluff and 'Camp Disaster,' in Bastrop county; Caldwell county; Atascosa county; Laredo, in Webb county, and Stations 1-5 on the Rio Grande river, included between Carrizo and 'Cardita Bluff,' in the northwestern corner of Webb county."

The list, without notes or descriptions of new species, is as follows:

Cephalopoda: *Belosepia ungula*, Gabb. Wheelock, Smithville; *Nautilus* sp.? Milam Bluff, Brazos R. Gasteropoda: **Conus sauridens*, Conr. Devil's Eye; San Antonio F.; Smithville; Caldwell; *Pleurotoma alveata*, Conr.; *P. capax*, Whitf.; **P. denticula* Basterot; **P. (Moniliopsis) elaborata*, Conr., Wheelock; *P. platysoma*, Heilpr., Atascosa Co.; *P. Tuomeyi*, Aldr., Devil's Eye; *Drillia Texana*, Conr., Wheelock; **Surcula Desnoyersii*, Lea, Smithville; *S. Gabbi*, Conr., Smithville; San Antonio F.; *S. Kelloggii*, Gabb, Wheelock; **S. lintea* Conr.; *S. Moorei*, Gabb, Smithville; Wheelock; **S. nodo-carinata*, Gabb, Devil's Eye; Wheelock; *S. Texana*, Gabb; *Turris Moorei*, Gabb, Smithville; Caldwell; *Exilia pergracilis* Conr.; *Cochlespira engonata* Conr., Caldwell; *C. bella* Conr.; *Cordiera Texana*, Conr., Smithville; Ala.; *Eucheilodon reticulata*, Gabb, Wheelock; Caldwell; *Scobinella crassiplicata*, Gabb, Wheelock; **Murex vanuxemi*, Conr., Smithville; *?M. (Odontopolys) compsorhytis*, Gabb, Wheelock; **Rostellaria (Calyptrophorus) velata*, Conr., near Alto; *Persona (Distorsio) septemdentata*, Gabb, Devil's Eye; Caldwell; Wheelock, Lee; *Clavella Penrosei*, Heilpr., Station 2; *Clavella ? enterogramma*, Gabb, Ala.; **Fusus salebrosus*, Conr., Smithville; **F. trabeatus*, Conr., Caldwell; San Antonio F.; *F. (Strepsidura?) Marnochi*, Heilpr., Atascosa Co.; *Fusus pagodæformis*, Heilpr., Smithville; *F. Mortoniopsis*, Gabb, Wheelock; Caldwell; **?Strepsidura (Muricidea?) bella*, Conr., Smithville; **?Bulbifusus inauratus*, Conr., Alum Creek Bluff; *Latirus (Cordiera) Moorei*, Gabb, Wheelock; Caldwell; *?L. (Cordiera) Texana* Conr.; *Fusimitra polita*, Gabb, Caldwell; *F. exilis*, Gabb, Wheelock; *Mitra* sp.? Devil's Eye; **Fusimitra lineata*, Lea, Wheelock; *Lapparia dumosa*, Conr., Smithville; Caldwell; Wheelock; Mississippi; *Caricella reticulata*, Aldr., Smithville; Ala.; *Volutilithes petrosa*, Conr., Devil's Eye; Alum Creek B.; San Antonio F.; Smithville; Lee

HEILPRIN, ANGELO.

Co.; Miss.; *V. *Sayana*, Conr., Well at Palestine, Anderson Co.; *V. precursor*, Dall, Wheelock; **Marginella semen*, Lea, Wheelock; Caldwell; *Cancellaria* (*Admete?*) *ellapsa*, Conr.; **Cancellaria tortiplica*, Conr., Smithville; *C. impressa*, Conr.; Smithville; Alabama; **C. plicata*, Lea, Caldwell; **C. gemmata*, Conr., Caldwell; **Oliva bombylis*, Conr., Caldwell; **?O. gracilis*, Lea; **Olivula staminea*, Conr., Smithville; *O. punctulifera*, Gabb, Wheelock; *?O. Texana*, Conr.; *Monoptygma crassiplica*, Gabb, Wheelock; *Ancillaria ancillops*, Heilpr., Smithville; Alum Creek B.; *Pseudoliva carinata*, Gabb, San Antonio F.; Caldwell; Wheelock; *P. fusiformis*, Gabb, Smithville; Wheelock; **P. sulcata*, Lea; **P. venusta*, Conr., Station 3, White Marl B.; *P. perspectiva*, Gabb, Smithville; Mississippi; **Lacinia alveata* Conr.; **Euthria* (*Lævibuccinum*) *prorsum*, Conr., Station 2; **Terebra venusta*, Lea, Smithville; *T. plicifera*, Heilpr.; **T. polygyra*, Conr.; **Terebrifusus amœnus*, Conr., Smithville; *Buccitriton Texanum*, Gabb, Sta. 3; Caldwell; Wheelock; St. Augustine; *B. scalatum*, Heilpr., Smithville; **Pyrula nexilis*, Lam., Smithville; *Natica* (*Neverita*) *arata*, Gabb, Alum Creek; Caldwell; Wheelock; *?N. Moorei*, Gabb, Caldwell; *N. Dumblei*, Heilpr., Station 2; **N. minor*, Lea, Smithville; **Natica limula*, Conr., Smithville; **Sigaretus canaliculatus*, Sowerby, Smithville; *Xenophora confusa*, Deshayes, Devil's Eye; *Solarium Meekanum*, Gabb, Wheelock; Caldwell; *S. Texanum*, Gabb, Wheelock; *S. vespertinum*, Gabb, Caldwell; **S. alveatum*, Conr., Caldwell; **Tuba* (*Littorina*) *antiquata*, Conr., Smithville; *Scalaria staminea*, Conr., Smithville; *Turritella nasuta*, Gabb, Smithville; Caldwell; Wheelock; **Turritella carinata*, Lea, Laredo; well at Palestine, Anderson Co.; **T.* (*Mesalia*) *Claibornensis*, Conr., San Antonio F.; **T.* (*Mesalia*) *obruta*, Conr.; **T.* (*Mesalia*) *venusta*, Conr., Caldwell; *Eulima exilis*, Gabb, Caldwell; *E. tenua*, Gabb; *E. Texana*, Gabb; **Pyramimitra costata*, Lea, Smithville; **Cerithium Whitfieldi*, Heilpr., McBee School; *Cerithium Texanum*, Heilpr., Station 5; *Crepidula* sp.? Station 4; **Cylichna galba*, Conr., Smithville; Caldwell; Wheelock; *Volvula minutissima*, Gabb, Caldwell; Wheelock; *V. Conradiana*, Gabb, Caldwell; Wheelock; **Helcion Leanus*, Gabb, Caldwell; *Dentalium minutistriatum*, Gabb, Smithville; Wheelock; *Gadus subcoarctatus*, Gabb, Wheelock. ACEPHALA: **Corbula rugosa*, Lam., Smithville; St. Augustine Co.; *C. Texana*, Gabb, Smithville; *Tellina Mooreana*, Gabb, Caldwell; **Donax limatula*, Conr., Colorado R.; *Cytherea Yoakumii*, Gabb; *Cytherea* sp.? Station 5; **C.* (*Dione*) *discoidalis*, Conr., Station 3; Ala.; **C. Nuttallii*, Conr., Station 1; *C. Nuttalliopsis*, Heilpr., Devil's Eye; Ala.; **Grateloupia Moulinsii*, Lea; *Protocardium Gambrinum*, Gabb; **Lucina alveata*, Conr., Station 1; **?Mysia ungulina*, Conr., Devil's Eye; **Astarte tellinoides*, Conr., Smithville; Devil's Eye; **Cardita planicosta*, Lam., Laredo; Lee Co.; well at Palestine, Anderson Co.; *C. Mooreana*, Conr., Lee Co.; **C. alticosta*, Conr., Camp Disaster, Colorado River; St. Augustine Co.; *Cardita tetrica*, Conr., Smithville; Devil's Eye; Mississippi; **C. rotunda*, Lea, Smithville; *Crassatella antestriata*, Gabb, Wheelock; *C. Texana*, Heilpr., Smithville; McBee's School; near Alto; St. Augustine Co.; **Nucula magnifica*, Conr., Caldwell; Devil's Eye; **Leda bella*, Conr., Smithville; *L. compsa*, Gabb, Caldwell; **?Yoldia eborea*, Conr., Smithville; *Pectunculus intercostatus*, Gabb; **?Limopsis corbuloides*, Conr.,

HEILPRIN, ANGELO.

Devil's Eye; *Limopsis pulcher*, Gabb, Wheelock; Caldwell; *Arca* (*Cibota*) *Mississippiensis*, Conr., Caldwell; Wheelock; near Alta; *Modiola Texana*, Gabb; *Pinna* sp.? Smithville; *Pecten* sp.? Station 4; **P. Deshayesii*, Lea, Burleson Shell B.; St. Augustine Co.; **P.* (*Camptonectes*) *Claibornensis*, Conr., St. Augustine Co.; *Plicatula filamentosa*, Conr., near Alto; *Spondylus* sp.?; **Ostrea Alabamensis*, Lea, near Alto; Burleson Shell B.; St. Augustine Co.; Station 5; Station 1; below Carrizo; Smithville; **O. sellæformis*, Conr., Smithville; Cherokee Co.; St. Augustine Co.; **O. divaricata*, Lea, St. Augustine Co.; *Anomia ephippioides*, Gabb, Station 2; McBee's; near Jacksonville; near Alto; *Natica Dumblei*, n. sp., Station 2, Rio Grande; *Cerithium Texanum*, n. sp., Station 5, Rio Grande; *Clavella* (*Fusus?*) *Penrosei*, n. sp., Station 2, Rio Grande; *Buccitriton scalatum*, n. sp., Smithville; *Ancillaria ancillops*, n. sp., Smithville; *Crassatella Texana*, n. sp., Smithville; McBee's School; near Alto; St. Augustine Co.

191. HERNDON, J. H.

Report of.

Scond Ann. Rept. of the Geol. Surv. of Texas, 1890, p. ciii. Austin, 1891.

Administrative report giving a brief account of a reconnaissance of Smith county with reference to its economic features. Acknowledgments.

192. ————————

Reports on the Iron Ore District of East Texas. Part III, Description of Counties. Chapter VI. Smith County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 204-224. Austin, 1891.

Contents: Preliminary statement. Geography and topography. Iron ores. Lignites, etc.

"The general surface of the country presents the usual characteristics of the iron ore regions of the Gulf Tertiary of Texas. It consists of a series of hills and plateaus, with narrow undulating valleys, the whole surface being cut by numerous streams and deep ravines. These divides are for the most part generally narrow, but occasionally broaden into wide and extremely level plateaus, sometimes several miles in breadth, and are capped by strata of iron ore of varying thickness, to the presence of which the ridges owe their very existence." Pp. 204-205.

"The iron ore ridges are covered by a dense forest growth of oak trees, hickory, pine, walnut, sassafras, mulberry, cottonwood, etc., and have generally an altitude of from three hundred and fifty to seven hundred feet above the sea level, and are from one hundred to two hundred and fifty feet higher than the main drainage grooves of the Sabine and Neches." P. 205.

"There are six localities in the county where ore occurs in sufficient quantities to render it commercially valuable. * * *

"The first of these is the Garden Valley bed.

* * * * * * *

HERNDON, J. H.

"The second iron field is the Steen Saline or Lindale bed.

* * * * * * *

"The third bed is on Price's survey, still further east of Lindale. * * *

"East of Winona and northwest of Starrville is another quite extensive bed of ore.

* * * * * * *

"Eight miles northeast of Tyler is another smaller outcropping of good ore.

* * * * * * *

"The last locality is that of the Gandy Mountain between Bullard and Troupe."

193. HIDDEN, WILLIAM EARL, and MACKINTOSH, J. B.

A Description of Several Yttria and Thoria Minerals from Llano County, Texas.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 474-486. New Haven, Dec., 1889.

History of the Discovery of Gadolinite, July, 1886, by J. J. Barringer, in Llano county, Texas. Description of the Locality. Occurrence of rare Minerals. Descriptions of Minerals: Quartz, Hyalite, Orthoclase, Albite, Biotite (?), Muscovite, Magnetite, Martite, Gadolinite, Yttrialite, a new Thorium-Yttrium Silicate:

"The mineral which we have named *Yttrialite* was discovered associated with, and often upon, the gadolinite, and but for its characteristic orange-yellow surface alteration (that of gadolinite immediately alongside of it being invariably of a dull brick red color) it might have continued to pass for 'green-gadolinite,' which was the local name given to it. Of these yellowish masses one weighed over ten pounds, and twenty kilos were found in all. Upon being broken open they are of an olive-green color, tending in places to a drab shade. Peculiar minute ragged lines permeate the mineral in all directions, causing an apparent muddiness or semi-opacity. No crystals have as yet been observed, but a seemingly ortho-rhombic symmetry was apparent in some of the masses. The mineral breaks easily in two directions with a shell-like fracture, but separates into small flakes very readily. (Gadolinite is broken only with difficulty.) Nothing like a cleavage has been noticed. A thin white crust of a mineral related to tengerite occupies the cracks in the mineral, and this is equally true concerning the gadolinite of the locality, as Genth has already noted. We have named the mineral *yttrialite,* in allusion to the prominent part played by the yttria earths in its composition.

"The specific gravity is 4.575; hardness=5—5.5. It is readily soluble in hydrochloric acid. When heated over the Bunsen flame it decrepitates violently, and falls to powder upon being ignited over a blast, becoming snuff-brown, infusible and insoluble. These characteristics serve to at once distinguish it from gadolinite, whch has specific gravity from 4.2 to 4.3 (Texas varieties), and which, when heated, glows vividly and swells into ragged fragments. The analysis shows several fractions of the

HIDDEN, WILLIAM EARL, and MACKINTOSH, J. B.

yttria earths (A, B, C, D), which were separated by successive precipitations with sodium sulphate. The atomic weight of each fraction was determined, showing successive increase with each separation. The fractionation was discontinued after the fourth separation, as the amount of material was getting very small, but the atomic weight shows that the lanthanum and didymium are still mixed with an earth of higher atomic weight.

"The results obtained are as follows:

		Atomic weight.	Oxygen ratio.	
$Si\,O_2$	29.17%			97.234=4
$Pb\,O$	0.854		0.383	
$Th\,O_2$	12.00		9.108	
$Mn\,O$	0.77		1.084	
$Fe\,O$	2.89		4.014	
$Ca\,O$	0.60		1.071	
$Al_2\,O_3$	0.55		1.617	
$Ce_2\,O_3$	1.86		1.722	72.918=3
(A) $Y_2\,O_3$	22.67=	110.3	25.320	
(B) $Y_2\,O_3$	5.30=	110.53	5.910	
(C) $Y_2\,O_3$	4.50=	114.9	4.860	
(D) $Y_2\,O_3$	14.03=	120.	14.616	
$(La\,Di)_2\,O_3$ etc	2.94=	162.	2.370	
$U\,O_3$	0.83		0.843	
Ignition loss	0.79			
	99.754			

Total yttria earths=............ 46.50% ....erbia spectrum distinct.'

Analyses of Gadolinite by Genth* and Eakins.† Thoro-Gummite, a Hydrated Uranium Thoro-silicate:

"This mineral, of which we have been able to gather about one kilo, occurs intimately associated with fergusonite and cyrtolite, and masses up to three ounces have been found, though for the most part it is in very small pieces. It is of a dull yellowish-brown color, has hardness above that of gummite, or 4—4.5, and occurs commonly massive, though several well defined groups of zircon-shaped crystals have been discovered with angles near to those of zircon. It has a characteristic color, after ignition, becoming of a dull greenish hue. Thus it is distinguished from freyalite, eucrasite and thorite, which species it otherwise resembles in some respects. Its specific gravity varies from 4.43 to 4.54. It is easily soluble in nitric acid. The analytical results are:

---

*Amer. Jour. Sci, III, Vol. XXXVIII, p. 200, Sept., 1889.

†See Eakins, L. G. (Gadolinite, Llano Co., Texas). Title 155.

HIDDEN, WILLIAM EARL, and MACKINTOSH, J. B.

				Oxygen ratio.
Si O_2	13.085			43.62 = 2.000
U O_3	22.43			23.37 = 1.071
Th O_2	41.44		31 22	
Al_2 O_3	0.965		2.83	
Fe_2 O_3	0.845		1.59	
(Ce Y)$_2$ O_3, etc.	6.69	Atomic weight =135.	6.30	43.64 = 2.001
Pb O	2.16		0.97	
Ca O	0.41		0.73	
H_2 O	7.88			43.78 = 2.008
P_2 O_5	1.19			
Moisture	1.23			
	98.325			

* * * * * * *

"We name this mineral *thoro-gummite* because it is a gummite in which the water has been replaced by the thorite molecule.

"Nivenite, a hydrated Thorium-yttrium-lead Uranate:

"This mineral we found intimately associated with fergusonite and thoro-gummit. It is as yet a rare mineral at the locality. Its specific gravity is 8.01, H.=5.5. It is velvet-black in color, and when powdered becomes brown-black. After ignition it turns blue-black. As yet only massive pieces have been found, but some of these suggest that the species may be isometric in crystallization. It is easily soluble in nitric and sulphuric acid, and some slight effervescence was noticed upon dissolving the mineral. The analysis gave the following results:

				Oxygen Ratio.
U O_3	46.75			48.69=12.
U O_2	19.89		14.62	
Th O_2	7.57		5.74	
Y_2 O_3 etc	11.22	Atomic weight 124.2	11.34	37.33= 9.20
Fe_2 O_3	0.58		1.08	
Pb O	10.16		4.55	
(Ignition) loss H_2 O	2.54			14.11= 3.48
Insoluble	1.22			
	99.93			

* * * * * * *

Analyses of Cleveite and Bröggerite. Fergusonite:

"This heretofore rare mineral occurs in large quantity at this new locality. Up to this date we have received over seventy kilos, some masses of which weighed over a pound. Broken prisms, rough in form, rarely showing terminal planes and masses of crystals interlacing each other is the manner of occurrence. The immediately associated minerals are cyrtolite and thoro-gummite, and also magnetite. The gadolinite also sometimes encloses it. It also occurs alone in a matrix of orthoclase or of quartz. One large mass of this kind of gangue, upon being broken up, yielded over thirty kilos of pure mineral in the form of fragments, most of which were basal sections of crystals which had been originally four to eight inches long and about one and a half c. m. thick.

"We have found two distinct varieties, of which we here append analyses and description.

HIDDEN, WILLIAM EARL, and MACKINTOSH, J. B.

"*Fergusonite, mono-hydrated.*—Specific gravity=5.67. Hardness 6—6.5, form tetragonal, with acute octahedral terminations, a zirconoid plane hemihedrally developed and, rarely, the basal pinacoid. The crystals are rough and dull gray exteriorly, but with a bronzy sub-metallic appearance on the surface of fracture, which is small conchoidal and brilliant. Thin splinters show a yellowish-brown translucence. Color, bronzy hair-brown. Streak and powder dull brown. It is infusible, but on ignition the powdered mineral changes to a pale olive-green color, and a momentary glow creeps over the mass at the point of redness. Fragments decrepitate violently when heated. With a microscope a peculiar light brown muddiness is noticed, and the mineral is filled with minute streaks and spots of a darker shade, all of which may indicate incipient alteration.

"Crystals often have a thin coating of, or are otherwise partly altered to, the tri-hydrated variety next described. It is decomposed when in fine powder by hydrochloric acid, with separation of columbic acid. The analytical results are as follows:

			Oxygen ratio.	
Cb_2O_5	46.27%			86.30
UO_3	1.54			1.59
ThO_2	3.38		2.56	
Al_2O_3	0.09		0.27	
Fe_2O_3	0.98	Atomic weights,	1.83	
(A) Y_2O_3*	23.95	110.55	26.70	
(B) Y_2O_3*	18.38	113.3	20.07	52.65
PbO	1.43		0.64	
ZnO	0.24		0.30	
CaO	0.10		0.18	
MgO	0.04		0.10	
Ignition H_2O	1.98		11.00	
110° C. H_2O	0.04			15.79
F	0.91	Atomic Ratio,	4.79	
	99.33			
Less O = F	0.38			
	98.95			

*Total Y_2O_3, etc., and Ce earths=42.33."

* * * * * * *

"*Fergusonite, tri-hydrated.*—Specific gravity=4.36—4.48, hardness about 5. Color deep brown, almost black, thin edges show a yellowish-brown translucence. Form and exterior appearance same as the species previously described. Streak and powder pale greenish-gray. On ignition turns light brown, but does not glow nor decrepitate like fergusonite. Is decomposed by hydrochloric acid with separation of columbic acid.

HIDDEN, WILLIAM EARL, and MACKINTOSH, J. B.

ANALYSIS.

				Oxygen Ratio.
Cb_2O_5	42.79			79.95
UO_3	3.12			3.24
UO_2	3.93		2.90	
ThO_2	0.83		0.62	
Al_2O_3	0.85		2.49	
Fe_2O_3	3.75	Atomic weight,	7.03	51.08
Y_2O_3 etc.	31.36	= 121.77	32.28	
PbO	1.94		0.87	
CaO	2.74		4.89	
Ignition H_2O	7.57		42.05	
110° C. H_2O	0.62			44.69
F	0.502	Atomic ratio,	2.64	
	100.002			
Less O = F	0.206			
	99.796			

Allanite. Molybdenite. Molybdite. Cyrtolite. Fluorite. Gummite. Tengerite (?); Fetid Gas.

194. HIDDEN, WILLIAM EARL.

On Mackintoshite, a new thorium and uranium mineral, with analyses by W. F. Hillebrand.

Amer. Jour. of Science, III, Vol. XLVI, pp. 98-103. New Haven, Aug., 1893.

"History.—It is three years since an alteration product of the new species here described was announced, jointly, by the late James B. Mackintosh and the writer, under the name of 'thoro-gummite.' In the interim a most diligent search has been made at the locality in Llano county, Texas, to discover the mineral in quantity, and also, if possible, the parent mineral from which it was derived. In an endeavor to find some fragments of the unaltered mineral, I broke up nearly a kilogram of the thoro-gummite, with the result of finding less than one gram of a black mineral, which, from the position it occupied *within* the thoro-gummite, we concluded must represent the original species. I note here that some irregular cores, of a dark-brown translucent mineral, were also found, but they proved to be very soluble and not essentially different from the enclosing thoro-gummite. They had a density of 4.50.

"Some chemical tests, then made by the writer, proved the black mineral to be practically unaffected by hydrochloric or sulphuric acids, and the density as then determined was 5.361. Upon fusing a portion with sodium bisulphate a solution was obtained, and it was thus found to be a silicate containing about 23 per cent. of uranium oxide (calculated as UO_2), about 46 per cent. of thoria and a small per cent. of the 'rare earths.'

"No further data were then obtained from the scant material in hand, but its relation to thoro-gummite was made evident. It was among fresh shipments of the various thoria and yttria minerals, made direct from the locality (Llano county, Texas), that this mineral was again found and further analytical work made possible. The new material was unexpectedly found deeply embedded in massive cyrtolite and associated with fergu-

HIDDEN, WILLIAM EARL.

sonite. None was found embedded in the new crystals and masses of thoro-gummite. Some fifty kilograms of the broken cyrtolite were thoroughly searched through, with the result of finding only about two grams of *pure* material, and this came mainly from one mass, which had a very thin coating of thoro-gummite." Pp. 98-99.

"This paper contains a description of the mineral, an account of its chemical composition by Mr. W. F. Hillebrand, and a discussion of its composition. The author proposes "the name of mackintoshite for this new species in honor of that able chemist, the late Mr. James Buckton Mackintosh, of New York City."

195. ——————, and HILLEBRAND, W. F.

Description of Rowlandite.

Amer. Jour. of Science, III, Vol. XLVI, pp. 208-212. New Haven, Sept., 1893.

I. Historical and Descriptive Discussion, by W. E. Hidden.

"About one kilogram of the mineral described in this paper was found by the writer in rather large lumps among huge masses of gadolinite and yttrialite in a single shipment of the various yttria-bearing minerals sent to him some five years ago from the noted locality in Llano county, Texas.

"The alteration products attracted my attention at once by their dissimilarity to those of gadolinite, yttrialite and allanite from the same mine. Several preliminary trials proved the mineral to contain over sixty-one per cent. of the 'rare earths,' having a joint atomic weight of 118.5. * * *

"Prof. Rowland photographed the spectrum of this mineral, and also the 'earths' from its oxalates and found them to be not essentially different from those of gadolinite and other minerals rich in yttria. He, however, expressed the opinion that there were at least *a dozen unknown elements* in the so-called yttria group not yet separated. The scale on which he showed its spectrum represented a length of ten feet, and over *ten thousand* lines were noticed." Pp. 208-209.

"Description of the mineral.

II. Analysis and Discussion of Composition, by W. F. Hillebrand.

196. HILL, ROBERT T.

Review of

"A Partial Report on the Geology of Western Texas," consisting of a General Geological Report and a Journal of Geological Observations along the Routes traveled by the Expedition between Indianola, Texas, and the Valley of Mimbres, New Mexico, during the years 1855 and 1856; with an Appendix giving a Detailed Report on the Geology of Grayson County, by Prof. Geo. G. Shumard, Assistant State Geologist of Texas. Austin, 1886.

Amer. Jour. of Science, III, Vol. XXXIII, pp. 73-75. New Haven, Jan., 1887.

HILL, ROBERT T.

"The scarcity of knowledge concerning the details of geological structure in the vast area embraced within the political bounds of the State of Texas is proverbial, and so inextricably is the little knowledge that we possess involved in controversy that any light upon the subject, however feeble, is always welcome at this time. The appearance at this late day of a volume giving the detail of scientific exploration that took place over twenty-five years ago in that region has a double value. In the first place it indicates a revival of interest in geological investigation by a State government in which a once strong desire to make known its resources in a scientific manner was almost entirely killed by the wrangling among themselves of the scientific men employed to carry out its intentions. The knowledge of large regions of hitherto unpublished territory which it brings to us is specially welcome."

An account of the brothers, Benjamin E. and George G. Shumard, follows, and their erroneous conception of the Texas Cretaceous is pointed out.

197. ——————

The Topography and Geology of the Cross Timbers and Surrounding Regions in North Texas, with a map, pl. vi.

Amer. Jour. of Science, III, Vol. XXXIII, pp. 291-303. New Haven, Apr., 1887.

Contents: The Upper Cross Timbers. The Lower Cross Timbers. Prevalent Theories as to the Cross Timbers. Topographic and Geologic Characteristics: The Coast Plain, the "Black Prairie Region," The Central Denuded or Hilly Region, the Plateau or Panhandle Region, the Mountainous or Trans-Pecos Region. Geologic Section of the Cretaceous Strata of the State of Texas, as seen along the line of the Texas Pacific Railroad, from Elmo, Kaufman county, to Millsap, Parker county, and, with local variations of thickness, as it occurs throughout the State. Based upon personal observations.

"The Cross Timbers of Texas are two long and narrow strips of forest region between the 96th and 99th meridians, extending parallel to each other from the Indian Territory southward to the central portion of the State, forming a marked exception to the usual prairie features of that country. They have been deliniated upon several maps, but most accurately upon the one accompanying the 'Report on the Cotton Production of the State of Texas, with a Discussion of the Agricultural Features of the State,' by R. H. Loughridge, Ph. D., Special Agent of the Tenth Census, which has been adopted in the map illustrating the areal distribution of the geologic formations of the United States, published in Vol. V, of the Annual Reports of the Director of the U. S. Geological Survey.

"The traveler, in crossing this region of Texas from east to west, along the line of the Texas and Pacific railroad, views the Cross Timbers merely as a grateful relief to the monotony of the prairies, and sees little in them worth remembering. To the more careful observer, however, there are numerous points of interest bearing on their topographic and geologic relations, some of which are worthy of presentation.

* * * * * * *

HILL, ROBERT T.

"The Upper Cross Timbers.—From their greater altitude and their position, relative to the flow of the rivers, the more western of the Cross Timbers, although geologically lower in the series, is known as the Upper, in distinction from the eastern, or Lower. It extends southward from the Indian Territory, through the counties of Montague, Wise, Jack, Parker, Hood, Erath and Comanche, to near the Colorado river. Its eastern border at every point is clearly defined, the adjoining prairie region being invariably much higher in altitude. The western border is not so sharply marked, but it approximately coincides with the 98th meridian until near the 32d degree of latitude, when it bends to the westward, losing its identity by 'thinning out,' so that the boundary between the wooded and prairie region is not always apparent. The surface soil usually consists of an exceedingly fine-grained silicious sand, which is the detritus of the underlying strata. This sand is utterly untenacious, except when wet, and is readily distributed by the high winds over the surface so as to effectually conceal the underlying strata. A small amount of red clay from a neighboring stratum gives to the sand, when mixed with it, a dirt-yellow color.

* * * * * * *

"The character of the soil, as above described, is also constant along the eastern edge, but is varied along the western half of the timbers by the presence of a crumbling, fine-pebble conglomerate.

"The Lower Cross Timbers.—The Lower Cross Timbers are located about fifty miles east of the upper belt, and extend in a direction approximately parallel to it. They are separated their entire length by a prairie region, utterly destitute of timber. The western margin of the Lower Cross Timbers is clearly defined, as is the case with the eastern edge of the Upper member; but, instead of being below the level of the prairie it is always at a higher altitude. The soil of the Lower Cross Timbers, although also arenaceous, differs from that of the upper in many respects. It is feruginous and more fertile, averaging less than ninety per cent. of insoluble silica, while that of the upper usually exceeds ninety-seven. The difference in fertility of the soils produces a varietal difference in the flora, the trees attaining much larger proportions and the number of species being slightly greater. The average width of the Lower Cross Timbers does not exceed fifteen miles, and they lose their identity near the Brazos river, at Waco.

* * * * * * *

"The two belts of the Cross Timbers are entirely within the third, or Central Denuded Region, the eastern border of the lower timbers coinciding almost exactly with the western border of the second topographical area. The chief geologic agency in modifying the surface of this region, as before stated, has been subaerial erosion. The only elevation apparent is that which is common to the other areas, and which was due to the rising of the Rocky Mountain axes. The denudation resulting from the subaerial erosion has been very great, the whole of the geologic series, from the recent to far down into the Carboniferous, having been removed from its center or place of greatest denudation. * * * The Tertiary, if it ever existed there, has already been removed from this vast area, and the Cretaceous is rapidly yielding—in places entirely gone. This fact being true,

HILL, ROBERT T.

it is evident that the Cross Timbers cannot represent any post-Cretaceous sediments.

* * * * * * *

"Geologically, the area occupied by these timbers [the Lower Cross Timbers] consists of a series of coarse, friable, arenaceous sandstones, alternating with clays, whose position is beneath the shales and limestones; and, like them, its western projecting margin is constantly wearing away. The unique fauna, now being studied by Dr. C. A. White, and the presence of lignites, indicate that the sediments are those of shallow waters; they resemble basal groups of the cis-Mississippi region, and, Dr. White believes, the Dakota sandstones of Kansas. Elsewhere than in Texas this group would be considered the base of the Cretaceous; but such is not the case here, for it clearly rests upon four hundred feet of a second and lower series of limestone strata, and one that was greatly eroded before these sands were deposited.

* * * * * * *

"On descending the escarpment at the western edge of the Grand Prairie, we reach the sandy soil of the Upper Cross Timbers. A geologic section will show that the surface soil is detritus of the underlying strata, which dip to the east, under the adjacent limestone prairie. This series of sandy strata varies in structure as we descend them. The upper strata abound in Dinosaurian bones and teeth, the lower in Lepidodendrons and Calamites. They mark the contact of the basal Mesozoic and the Carboniferous.

"The sands of the eastern half of the Upper Cross Timbers are purely siliceous, fine-grained, and utterly free from any cementing matrix. They are so friable that they quickly lose all appearance of original stratification on exposure, and were it not for railroad-cuts and well-borings through the overlying Cretaceous limestone, their true stratigraphic position would still remain obscure. The pure white sands of this series can be traced along the eastern border of the Cross Timbers for over a hundred miles. These sands constitute the receiving reservoir for the artesian wells of Fort Worth and Dallas, their strata dipping at such an angle under the Grand Prairie that they are reached at a depth of 350 feet beneath the first named place, and about 750 at the latter."

198. ——————

The Texas Section of the American Cretaceous.

Amer. Jour. of Science, III, Vol. XXXIV, pp. 287-309. New Haven, Oct., 1887.

Introduction: The Cretaceous Areas of the United States. Great similarity of the molluscan faunæ, with varying lithologic characters. Loose use of the term "groups," which "are really 'horizons' representing the culmniation of species or sedimental variations.

* * * * * * *

"If the Lower Cross Timber sands be of the age of the Dakota sandstone, as has been ascertained by Shumard and others, and since when present they rest directly on top of this division, then we have in Texas

HILL, ROBERT T.

not only the whole section of previous writers often visible in connected exposure, but a new and lower group of the marine Cretaceous beneath the hitherto recognized groups.

"In this journal of January, 1887, I first called attention to the fact that the current ideas of the relations of the Cretaceous strata of Texas were erroneous. In a paper read before the Philosophical Society of Washington, January 29, 1887, I published a local section, typical of the whole region, including the strata from the Tertiary to the Carboniferous, and a condensed summary of the paleontology, stratigraphy and literature of the Cretaceous strata of Texas. I demonstrated the transitional position these strata occupied between the Atlantic States bordering upon the Gulf of Mexico and those of the Rocky Mountain region, and showed the existence there of a deep marine group of the Cretaceous, which is older than any hitherto recognized on this continent. In a paper read before the Philadelphia Academy of Science, February 5, 1887, Dr. C. A. White published a résumé of the section furnished him by me for that purpose, together with some brief deductions thereon and some correlations of his own. In the present paper, to which the former was but introductory, I propose to diagnose more clearly this lower group, and to explain many new features of it which throw much light upon the American Cretaceous section." Pp. 289-290.

The Austin-New Braunfels Non-conformity. "This non-conformity is clearly and unmistakably visible in and near Austin, San Marcos, Heliotes and New Braunfels; and this relation of the strata, which is the same along the face of the escarpment from Austin to Rio Grande, is diametrically opposite to that originally announced by Roemer (and accepted by Shumard and other writers down to the present day) [with the exception of Professor E. D. Cope], who made the Cretaceous of the plain at the foot of the highlands older than that of the plateau, and to extend under it, as shown in the following diagram. This error, which was the fundamental cause of the confusion of knowledge concerning the Texas Cretaceous formation, has existed since Roemer's time." Pp. 292-293.

The Upper Division of the Texas Cretaceous. Its characters and paleontology. List of Fossils.

Middle Division of the Texas Cretaceous. Lithologic characters. Source of the confusion in Dr. B. F. Shumard's composite section. Fossils in the shales at Austin, Eagle Ford and New Braunfels. Contacts on the south banks of the Colorado at Austin, and in the east bank of Shoal Creek. Faunal and stratigraphic break. The Lower Cross Timber Series wanting south of Waco. Meek on the relative age of the Dakota Sandstone of the Rocky Mountains and the Cross Timber beds. Fauna of the Middle Division of the Cretaceous.

The Lower Division of the Texas Cretaceous. "The harder limestones, seen underneath the Lower Cross Timber beds at Fort Worth and Denison and the shales at Austin, and forming the face and plateau of the escarpment, are the undoubted top of the Comanche series of my former paper. This great formation, which constitutes the face of the escarpment and the great plateau at its top, covers or once covered the whole of the central region as far west as the Rocky Mountain region. This group of strata embraces thousands of feet of deep marine sediments, and extends over

HILL, ROBERT T.

an immense area in Texas. At San Marcos, New Braunfels, Austin, and many other places throughout the central region, the strata are beautifully shown. Four miles northwest of the latter city the banks of the Colorado afford a vertical exposure of over 700 feet, and yet these are only the topmost strata of the series. The strata dip rapidly to the southeastward." Pp. 299-300. Lithologic Characters.

The Central Denuded Region. Its boundaries. Geology.

The Washita Division. Fauna of the Upper, or Washita Division.

The Fredericksburg Division. Lithology and Topography. Fauna of the Lower or Fredericksburg Division. Basal Contacts. "Several years of most careful study of the stratigraphy of the whole of the Comanche Series fully confirms its position to be lower than the strata of the Lower Cross Timber beds, which Shumard, White and other authorities have asserted to be identical with the Dakota Sandstone of Meek and Hayden, and hence lower than any of the hitherto described marine groups of the American Cretaceous." Paleontologic break between the Comanche and upper series. Review of the Fossils of the Comanche Series. Conclusions.

199. ——————

The Present Condition of Knowledge of the Geology of Texas. Bulletin of the United States Geological Survey, No. 45, 95 pp. Washington, 1887.

Contents: Prefatory Note. I. Historic Statement of Geologic Investigation. Knowledge at the Beginning of this Century. Anglo-American Adventurers and Colonists: Philip Nolan; American Colonization Period. European Investigators: William Kennedy; G. A. Scherpf; Prince Carl Solms-Braunfels; Victor Bracht, Ferdinand Roemer. United States Military Reconnaissances and Explorations: Reconnaissances; Explorations: Exploration of the Red River of Louisiana; United States and Mexican Boundary Survey; Pacific Railroad Surveys: Thirty-fifth Parallel Survey; Thirty-second Parallel Survey; Artesian Well Experiment. Geologic Surveys conducted by the State: The Texas Land Office; First Geological Survey (Shumard): Organization and Equipment; Field Labors; Methods of Survey; Maps; Operations of 1860; Official Results; Indirect Results; Expense. Second Geological Survey (Glenn-Buckley): Operations of 1874; Operations of 1875. Recent Miscellaneous Investigations: Individual Contributors; Work of the United States Geological Survey. Succession of Scientific Explorations.

II. Summary of Results: Topography: Classification of Topography of Texas; Chart illustrating Progressive Classification of Topographic Features. Historic Geology and Stratigraphy: Table of Geologic Formations of Texas, with Authorities; So-called Archaean and Earlier Paleozoic; Carboniferous System: Central Carboniferous Area, Trans-Pecos Carboniferous Area. General Conclusions respecting the Texas Carboniferous. So-called Permian or Permo-Carboniferous; Trans-Pecos Region of Shumard; Permian of Cope and his Assistants. Jura-Trias or Gypsum Strata. So-called Jurassic. Cretaceous. So-called Laramie. Tertiary. Quaternary and Other Post-Tertiary Strata. Geological Deductions. General

Hill, Robert T.

Conclusions.

"Geologic investigation in Texas has been fragmentary and unsatisfactory for many reasons: Hostile Indians till recently ravaged the western half of the State; the civil war suspended the work of a comprehensive geological survey inaugurated under the State legislation of 1858, and that survey resuscitated and a later organization both came to naught. The U. S. Geological Survey has extended its operations into the State too recently to increase greatly the published knowledge of the geology of Texas.

"To study intelligently the geology of this State it is important that a digest of such material as has been already published should be made. The present bulletin comprises an historical statement of such scientific work as has added to available knowledge of the topography and the paleontology as well as the geology of the State, but it is not intended to include unpublished knowledge gained by my residence and study in the State, except as that knowledge modifies comments on conclusions already in print. Other publications will embody such matter in due time. The present work does not extend the record beyond January 1, 1886."—P. 7.

200. ——————

The Trinity Formation of Arkansas, Indian Territory, and Texas. Science, Vol. XI, p. 21. Jan. 13, 1888.

"In previous papers (*American Naturalist*, Feb., 1887; *American Journal of Science*, April and October, 1887), I have shown that the Mesozoic strata of the Texas region, instead of belonging to the uppermost Cretaceous, as had been previously supposed, really embraced a large series of lower Cretaceous, and perhaps Jurassic beds. To the last-named period I intimated that the strata in Parker county, Texas, provisionally termed in my section the 'Dinosaur Sands,' would probably be found to be related. The studies of the past season in Arkansas have shown that these strata exhibit a great uniformity of deposition along the paleozoic and mesozoic parting from south of the Brazos river in Texas to the Little Missouri river near Antoine, Pike county, Ark., a distance of over three hundred miles, and that they rest directly upon the highly disturbed Carboniferous rocks. In Texas the areal extent of this formation coincides with the eastern half of the Upper Cross Timbers, and in Arkansas it extends from the point above mentioned westward to beyond Ultima Thule. Its width, except for a few miles on each side of Red river, never exceeds a few miles. The formation consists of alternations of fine, closely packed white sands and red and blue gypsiferous marls, with occasional alternations of thin but extensive fissile, arenaceous, and crystalline limestones, highly fossiliferous, often wave-marked, and seldom more than ten inches in thickness. Extensive strata of pure saccharoidal gypsum also occur in places, and the formation is the source of the salines and salt licks throughout its extent, and probably also of the 'brackishness' of the rivers which intersect it. * * *

"West of Weatherford [Texas], the basal Comanche series may be seen resting directly upon it, while at the point of its disappearance under the

HILL, ROBERT T.

newer strata in Arkansas, it is directly covered by the uppermost Cretaceous of Hilgard's Mississippi section."

The fauna is littoral. Its characteristic molluscan species indicate upper Jurassic and Wealden. To the continuous formation the name "Trinity" is applied. It includes the "Dinosaur Sands" of the Texas section.

201. ————————

The Neozoic Geology of Southwestern Arkansas.

Annual Report of the Geological Survey of Arkansas for 1888, Vol. II. Little Rock, 1888.

(The Typical Section of the Texas Cretaceous.) Chapter XI, pp. 110-115.

See "The Texas Section of the American Cretaceous," by Robert T. Hill. Amer. Jour. of Sci. ante.

202. ————————

Notes upon the Texas Section of the American Cretaceous. (Abstract.)

Proceedings of the Amer. Assoc. Adv. Science, Vol. XXXVI, p. 216. 1888.

"Owing to its peculiar transitional geographic position and the favorable conditions of exposure of its strata, the State of Texas presents the best opportunity for the study of the American Cretaceous, which has there the most comprehensive vertical range."

In this brief paper are pointed out: (1) That both the Gulf series or Mississippi section of Hilgard, with the exception of the Eutaw formation, and the Rocky Mountain series or Nebraskian section of Meek and Hayden, extend into the State by direct stratigraphic continuity. (2) That Roemer, Shumard and others had fallen into some stratigraphical errors; and (3), that beneath the Dakota sandstone of the Hayden section, as previously mentioned in a paper before the Philosophical Society of Washington, January 29, 1887, there exists an older marine group of sediments with a fauna greatly resembling that of the Neocomian or Lower Cretaceous of Europe.

203. ————————

The Geology of Texas.

Texas School Journal, Vol. VI, N. S. 143-145. Austin, June, 1888.

The true meaning of Geology. What is geologically known of Texas. (1) There is no good geographic map of the State, except for a few square degrees in the center recently surveyed by the U. S. Geological Survey. (2) The stratigraphy of the State has never been mapped and published. (3) There is little definite knowledge published concerning

HILL, ROBERT T.

its economic resources. Extract from the recently printed Encyclopædia Brittanica upon the resources of Texas.

204. ———————

Notes on the Geology of Western Texas.

Geological and Scientific Bulletin, Vol. I, No. 6. Houston, Oct., 1888.

The prairie and mountainous areas of western Texas, as along the Texas and Pacific railway, furnish a rich field for scientific investigators. From Millsap to Cisco the prevailing rocks are Upper Carboniferous. General westward dip of the Carboniferous strata. Topography near Cisco. The "Red Beds" west of Cisco. The Permian and the Jura-Trias. The continuation of the great plains west of Sweetwater—Tertiary or Quaternary. The line of Cretaceous buttes and mesas south of the railway. Extent. Mountains west of the Pecos. Eruptive and sedimentary material. Quaternary and Post-Quaternary lake basins. Evidence afforded by the State of Quaternary and Post-Quaternary phenomena. Distribution of the Post-Glacial Mastodon from El Paso to Dallas, and from Wichita to the Rio Grande. Pre-Cretaceous beds of lignite. Boundaries of the areas of positive knowledge brought by the Arkansas Survey of the Texas frontier.

"Since writing the foregoing I have made another trans-section of the wonderful west Texas region. This time from Texarkana westward to Henrietta, and from thence northwest, over the plains and up the valley of the Canadian to Tucumcari mountain, in New Mexico. * * * It is sufficient to say, however, that this journey not only verifies the geologic phenomena along the Texas Pacific, but elucidates them so clearly as to render them conclusive. The surface of the Llano Estacado is an early quaternary loam, and a direct continuation of the great plains of Kansas and Nebraska, while the white-matrixed conglomerate above alluded to, which appears so clearly as the surface of the valley dividing the north and south plains, is a later quaternary deposit." P. 4 of reprint.

A geological interpretation follows.

For review, see Amer. Geologist, Vol. III, pp. 51-52.

205. ———————

University of Texas. School of Geology.

Circular No. 1, p. 1. Austin, 1888.

This circular was designed to accompany Bulletin No. 45 of the United States Geological Survey, entitled "The Present Condition of Knowledge of the Geology of Texas." Since the writing of this Bulletin, 1885, much has been added to our knowledge of the State. The accompanying reprint from the Texas Scientific Bulletin for November [Oct. ?], 1888, indicates the character of some of these observations.

"Among other subjects of recent discovery of interest to stratigraphic geologists may be mentioned the following:

"1. The occurrence of the undoubted Laramie of the Colorado region along the Texas side of the Lower Rio Grande.

"2. The demonstration of the chalk origin of the Texas Cretaceous

HILL, ROBERT T.

(upper and lower), with its flints, sponges, foraminiferae, and many other fossil remains, hitherto not believed to exist in America, together with some new stratigraphic horizons.

"3. The demonstration of an extensive Mesozoic igneous area in Central Texas now being studied by the State Geologist and the writer.

"4. The reaffirmation of the age of the Tucumcari section along the northwest corner of the Texas to be uppermost Jurassic, as originally described by Marcou, and the probable development of an extensive marine Jurassic formation in southwest Texas and northern Coahuila and Chihuahua.

"5. Innumerable mineralogic data by Professor Edgar Everhart and others.

"6. Many questions of undoubted economic importance, such as the development of the Tertiary petroleums of Eastern Texas, the wonderful magnetite iron beds of Llano county; the inexhaustible beds of flint suitable for emery and glass making; chalk of commercial value and purity equal to that of France; kaolins, agricultural marls, Portland cement and other valuable products.

"7. The scientific classification of the soils of Texas is in progress by the writer, and the stratigraphic conditions for determining artesian wells are gradually being developed."

206. ———————

The Permian Rocks of Texas.
Science, Vol. XIII, p. 92. Feb. 1, 1889.

Attention is here called to the fact that there is in Texas "a great series of beds, beginning west of the 97th meridian, and succeeding the Carboniferous; and beneath the undoubted Wealden beds of the Cretaceous a great development of strata, the lower half of which cannot possibly be referred to any other age than the Permian, although the upper portion is probably Triassic. Professor Cope has long since described the vertebrates of these Permian beds, and the Mollusca, I am informed, are now being examined. The stratigraphy, however, has as yet only been reconnoitered, and no section whatever determined. * * * The stratigraphic features agreed, as far as could be seen, in nearly every generality with those of the Kanab Valley of Utah as described by Mr. C. D. Walcott a few years ago in the *American Journal of Science*, and were the direct eastward continuation of the same. Not only does this similarity agree with the Permian beds, but with the upper beds, which he calls Triassic. This connects the Grand Cañon and Texas-Permian-Triassic basin beyond all doubt; and to Mr. Walcott belongs the credit of the first and only intelligible section of the American Permian, a most marked and unmistakable terrane, the discovery of which was made, as agreed, by Professor Jules Marcou."

207. ———————

(On the Occurrence of Macraster Texanus.)
Amer. Naturalist, Vol. XXIII, p. 168. Feb., 1889.

"In the 'Neues Jahrbuch für Mineralogie, Geologie, and Paleontologie, Jahrgang, 1888, I Band, drittes Heft,' Dr. Ferd. Roemer describes and

HILL, ROBERT T.

figures a new genus of Echinodermata from Texas, to which he gives the name of 'Macraster,' and calls the only species *Macraster texanus*. This fossil has long been familiar to the writer in his stratigraphic investigations in Texas, and it makes a well defined horizon near the very top of the immense thickness of lower marine Cretaceous in Texas, and does not occur, as Dr. Roemer infers, from the specimens which accompanied it to Germany, with the *Exogyra texana* fauna, a statement which has been verified by Mr. Geo. Stolley, the collector. This fact is important because of the tendency upon the part of European paleontologists to underestimate the value of the stratigraphic differentiation of the Texas Cretaceous."

208. ————————

(On the Validity of some New Species from the Cretaceous of Texas.)

Amer. Naturalist, Vol. XXIII, p. 169. Feb., 1889.

"Herr Schlüter, in two papers entitled 'Ueber die regulären Echinodermata der Kreide Nord Americas,' and 'Ueber Inoceramus und Cephalopoden der Texanischen Kreide,' (Niederrhein, Gesselschaft at Bonn, March, 1887), describes *Salenia mexicana*, from Chihuahua, Mexico, and *Inoceramus subquadratus*, *Turrillites irrideus*, and *T. varians* from Austin, Texas. The validity of the three species last mentioned is exceedingly doubtful, as the descriptions give no data sufficient to differentiate them from species already described by Roemer and Shumard. He also asserts that the Austin Cretaceous is equivalent to that of Ems, Germany, a rather indefinite statement, since within the corporate limits of Austin is found nearly the whole range of the comprehensive Texas Cretaceous under conditions which could hardly be duplicated."

209. ————————

Events in North American Cretaceous History Illustrated in the Arkansas-Texas Division of the Southwestern Region of the United States.

Amer. Jour. of Science, III, XXXVII, pp. 282-290. New Haven, April, 1889.

Contents: Continental Limitations at the Beginning of the Cretaceous. The First Epoch of Subsidence. The Second Epoch of Subsidence. Disturbances and Differentiation at the Close of the American Cretaceous. Post-Cretaceous Events which have concealed Cretaceous History. Table showing Events, Epochs, Distinguishing Fossils, Prevailing Sediments, and Thickness in W. Texas.

"During the last two years the writer has been permitted, by the joint effort of Dr. John C. Branner, State Geologist of Arkansas, and the Director of the United States Geological Survey, to investigate the stratigraphic and paleontologic conditions of the northern and eastern termination of the Texas Cretaceous, and to trace out its detailed relations to those of the Gulf and western States with their accompanying phenomena. The con-

HILL, ROBERT T.

dition of knowledge previous to that time was fully set forth in this journal for October, 1887. From later investigations I am able to present the following brief sketch of the principal historical events recorded in their formations, and also a preliminary section which approximately outlines the Cretaceous history of the United States east of the Sierras." Pp. 282-283.

210. ——————

A Review of

"Ueber eine durch die Häufigkeit Hippuritenartiger Chamiden ausgezeichnete Fauna der oberturonen-Kreide von Texas, von Ferdinand Roemer in Breslau." Paleontologische Abhandlungen, Vierter Band, Heft 4. Berlin, 1888.

Amer. Jour. of Science, III, Vol. XXXVII, pp. 318-319. New Haven, Apr., 1889.

In Roemer's paper an interesting fauna from Barton's Creek, a locality near Austin, is described, embracing twenty-one species, of which eighteen are considered new.

"As the reviewer has made a special study of the faunal and stratigraphic horizons of these fossils, he would here correct one or two mistakes in the otherwise excellent publication. Instead of being from the Austin Chalk of Shumard (Niobrara of M. and H.), as the author asserts, all of these forms came from an entirely different and lower horizon, separated by four distinct subfaunas, a complete stratigraphic and paleontologic non-conformity, and four hundred feet of strata below that horizon, and hence the deductions and correlations of Dr. Roemer are unfounded."

The species described are considered as belonging to non-criterional genera and the conclusion advanced is that "Dr. Roemer's assignment of this fauna to the Upper Turonian horizon is not based upon sufficient evidence either stratigraphical or paleontological. They belong to the Hippurites Limestone of Shumard, whose stratigraphical place as given in my section is in the middle of the Lower American Cretaceous."

211. ——————

A Portion of the Geologic Story of the Colorado River of Texas. Amer. Geologist, Vol. III, pp. 287-299. Minneapolis, May, 1889.

Contents: Introduction. The Section. Unconformities and Disturbance. The Devonian. Disturbances closing the Paleozoic. The Early Mesozoic Hiatus. The Cretaceous History. The Upper Cretaceous Formation. The Tertiary. The Quaternary. Ancient River Terraces. Disturbances in the Cretaceous Formations.

This paper deals with the geological phenomena seen along the course of the Colorado river from the vicinity of Sand Mountain, in Llano county, to Austin, in Travis county. The formations exposed range from the Llano Group of Walcott to the Quaternary, and have an estimated thickness of 9,520 feet.

212. HILL, ROBERT T.

The Foraminiferal Origin of certain Cretaceous Limestones and the Sequence of Sediments in North American Cretaceous.

Amer. Geologist, Vol. IV, pp. 174-177. Minneapolis, Sept., 1889.

During the Cretaceous there were within the limits of the United States two distinct and long continued epochs of subsidence. The deposits range from arenaceous littorals "through arenaceous clay shales, clay shales and calcareous shales, into culminating chalk deposits of great thickness and extent."

In the uppermost Cretaceous rocks the chalky deposits of the Niobrara horizon have been noted in Kansas and elsewhere, and its continuation through Texas into southwestern Arkansas is apparent.

In the Lower Cretaceous strata of "pure unchanged chalk" are occasionally found, but most of the limestones are too hard to be called of a chalky texture, though they are of chalky origin.

A microscopic examination of the limestones, in the geological laboratory of the University of Texas, brought out the following facts: "None of the Lower Cretaceous limestones except a few feet of the basal (Trinity) sands showed brecciate or layers in laminate structure, indicative of littoral origin or were accompanied by littoral faunas. All the other Lower Cretaceous limestones are of a massive or pastry texture, unlaminated, and of varying hardness and purity, and when microscopically examined show an abundance of foraminiferal remains imbedded in a calcareous (calcite) matrix.

"The foraminiferae always exceeded in number the few molluscan remains, which were seldom found, thus clearly showing that these rocks are of chalky origin."

For the rocks of one horizon, consisting almost wholly of *Tinoporus texana*, the name of *Tinoporus Chalk* is proposed. Mention is also made of the causes productive of the "excessive metamorphism" which these rocks have undergone in several localities, as at Pilot Knob southeast of Austin.

"In addition to the two great chalk deposits of the Upper and Lower Cretaceous, respectively, there are but three limestone horizons in the entire sedimentation of the two Cretaceous formations of the southwest of other than foraminiferal origin, and they compose but a small fraction of the entire thickness." Here follows a description of the "non-foraminiferal" limestones.

Of the strata constituting the Lower Cretaceous, having a thickness of over 2,000 feet, 1,500 feet are limestones, "all but a hundred feet of which are of foraminiferal or semi-foraminiferal origin."

The paper closes with a paragraph on the sequence of the Cretaceous sediments.

213. ———————

Paleontology of the Cretaceous Formations of Texas.

University of Texas, School of Geology, Pt. I, 10 pp.; 3 plates. Austin, 1889.

HILL, ROBERT T.

Contents: Introduction. The Comanche Series or Lower Cretaceous Formation—The Shoal Creek (Vola) Limestone Fauna: Pecten (Vola?) Roemeri, sp. nov.; Pterocera Shumardi, sp. nov.; Crioceras? (Ancyloceras) Texanus, sp. nov.

214. ———————

A Preliminary Annotated Check List of the Cretaceous Invertebrate Fossils of Texas, accompanied by a short description of the Lithology and Stratigraphy of the System.

Geol. Surv. of Texas, Bulletin No. 4, pp. xxxi, 57. Austin, 1889.

Contents: Letter of Transmittal by E. T. Dumble, State Geologist.

Introduction. Preliminary Notes upon the Cretaceous System of the Texas Region: Present State of Knowledge of the Texas Cretaceous, Table showing Theoretical Relation of the Cretaceous System of Texas to other Cretaceous Rocks of the United States, east of the Sierras—1890, Explanation of the Nomenclature in this Paper.

A Brief Description of the Stratigraphy and Rocks of the Cretaceous Series of Texas, based principally upon a Preliminary Section along the Colorado River from near Smithwick Mills to Webberville.

Progress Section illustrating the Cretaceous System of Texas as investigated to January 1, 1890.

The Lower or Comanche Series (Colorado Section.) A.—The Trinity Division. B.—The Fredericksburg Division: The Basal Beds; Comanche Peak Subdivision: The Caprina Chalk and Chalky Limestone Subdivision. C.—The Washita Division: The Flagstones; The Upper Caprotina Limestone, or Austin Marble; The Washita or Fort Worth Limestone; The Exogyra Arietina Clays; The Shoal Creek Limestone; The Denison Beds.

The Stratigraphy of the Comanche Series in general.

The Upper or Black Prairie Series: The Lower Cross Timbers Sands; The Eagle Ford Shales; The Austin-Dallas Chalk, or White Rock; The Exogyra Ponderosa Marls. General Conclusions on the Upper Cretaceous Series.

Annotated Check List. Tabular View of the Stratigraphic Occurrence of the Invertebrate Fossils of the Cretaceous Formations of Texas. List of Faunas. Reference Bibliography.

Noticed in Amer. Jour. of Sci., III, Vol. XXXIX, p. 521, June, 1890.

215. ———————, and PENROSE, R. A. F., JR.

Relation of the Uppermost Cretaceous Beds of the Eastern and Southern United States, by Robert T. Hill; and the Tertiary Cretaceous Parting of Arkansas and Texas, by Robert T. Hill and R. A. F. Penrose, Jr.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 468-473. New Haven, Dec., 1889.

The Cretaceous outcrop at Arkadelphia, Ark.—A Cretaceous island. To the southwest the areal exposures become more extensive until in Central

HILL, ROBERT T.

and Southwest Texas they become the prevalent surface formations. Increase in thickness. Between Arkadelphia and the Pasezoic area of Central Texas there are 5000 feet of Upper and Lower Cretaceous deposits.

A Summary of Cretaceous Formations:

The Upper, or Black Prairie Formation (Gulf Series). Made up of five subdivisions. Thickness of each and localities of occurrence.

The Lower, or Grand Prairie Formation (Comanche Series). Made up of nine subdivisions. Thickness of each and localities of occurrence.

"The immediate objects of this paper are to call attention to (1) the beds of the uppermost or glauconitic division of the Upper Cretaceous, (2) to the important light they throw upon the Cretaceous beds of the Gulf and Atlantic States east of the Mississippi, and (3) to the complete nonconformity by erosion and deposition that exists between them and the basal beds of the Southern States Tertiary."

The sequence of sediments during the Upper Cretaceous subsidence and emergence. The Glauconite beds. The Texas exposure on the Trinity in Anderson County. The Exogyra ponderosa Marls. The Glauconite beds of New Jersey. Lamellibranchiate species common in America to Arkansas, Texas, Mississippi and the Lower Marl bed of New Jersey. None of the characteristic fossils of the New Jersey Cretaceous above the Lower Marl bed occur in the Arkansas-Texas Cretaceous. The conclusion on paleontologic and lithologic grounds is "that the uppermost beds of Arkansas are the southwestern representative, perhaps the direct continuation, of the lower marl beds of the New Jersey region, an opinion which is strengthened by the stratigraphic evidence, which shows a complete unconformity between the uppermost Cretaceous of Arkansas and Texas north of the Rio Grande. Also, that a large part of the glauconitic beds were eroded, and their debris redeposited in the Eo-Lignitic or basal beds of the Southern States Tertiary. The iron ores of the Southern Tertiary are primarily derived from this source. This fact has been determined by most careful observation on the part of Mr. R. A. F. Penrose, Jr., and the writer, in Texas and in Arkansas. The contacts in the latter region are described in full in my Arkansas Report, while those in Texas will soon be published in Mr. Penrose's report to the State Geologist, Mr. E. T. Dumble."

Geography of the Texas Cretaceous. Suggestion as to the use of the term "Glauconitic."

See Amer. Naturalist, Vol. 24, p. 769.

216. ———————

Classification and Origin of the Chief Geographic Features of the Texas Region. I.

Amer. Geologist, Vol. V, pp. 9-29. Minneapolis, Jan., 1890.

Contents: (Introduction.) The Plains of Texas. The Coast Prairies. The Sandy Lignitic, or Forest Area. The Black Prairie Region. The Balcones. The Shumard Knobs. The Grand Prairie. The Central Denuded Region. Older Rock Regions. The Red Beds. The Abilene Country. The Gypsum country. The Llano Estacado or Staked Plains.

HILL, ROBERT T.

"In this paper it is proposed to give a brief classification of the topographic and geologic features of the extensive area of Texas. Evidently so brief a mention of this vast region will be neither exhaustive nor detailed; It is a preliminary statement of some of the great features which will be more accurately delineated by those who, with better facilities, will hereafter conduct accurate surveys of this region, which has as yet been only partially reconnoitered."

217. ———————

Classification and Origin of the Chief Geographic Features of the Texas Region. II.

Amer. Geologist, Vol. V., pp. 68-80. Minneapolis, Feb., 1890.

Contents: The Valleys of Erosion: The Older Valley of the Canadian; The Older Valley of Red River. The River Terraces of the Black Prairie and Eo-Lignitic Regions. The Lake Basins of the Trans-Pecos Mountain Region. Mountainous and Disturbed Regions: The Ouachita Mountains; The Mountains of the Trans-Pecos Country. Epitome of the Chief Topographic Areas of the Texas Region. (Tabulated.)

218. ———————

Report of.

First Ann. Rept. Geol. Surv. of Texas, 1889, pp. lxxxiii-lxxxviii. Austin, 1890.

Administrative Report to the State Geologist. Geographic and Topographic Work. Stratigraphic Work. Reconnoissance. Cross-Section Work. Economic Investigations. Illustration. Office Work. Work of Assistants: Mr. J. A. Taff; Mr. N. F. Drake; Mr. C. C. McCullough; Mr. J. S. Stone.

"In accordance with your request upon organization of the Survey, I undertook, in February, 1889, * * * the study of the natural features of those portions of the State known as the Black and Grand Prairie regions and the accompanying Upper and Lower Cross Timbers, all of which are the surface features of the Cretaceous rocks, to which they owe their topographic individuality, economic possibilities, and conditions for human habitation.

* * * * * * *

"The extent and character of the region to be surveyed * * * embraced an area of over 72,512 square miles, or over one-fourth (27.75 per cent.) of the total area of the State—a region three times as large as the combined area of Massachusetts and Connecticut, Rhode Island, New Jersey, and Delaware, or three times the size of West Virginia. Since it would have been a physical impossibility for the whole force employed upon your Survey to have covered this enormous area with even a reconnoissance, it became a matter of necessity that the region should be divided into working districts, and the work of my assistants limited to some certain portion.

"In accordance with the necessity, the total area was subdivided, there-

HILL, ROBERT T.

fore, into the following artificial divisions for working convenience.

"1. Northern District, or portion north of the Colorado, including 24,000 square miles. * * *

"The Northern District was chosen as the best adapted for preliminary operations, and the work has been confined to that field."

219. ————————

A Brief Description of the Cretaceous Rocks of Texas and their Economic [Value] Uses. Based principally upon a Preliminary Section along the Colorado river from near Smithwick Mills, Burnet county, to Webberville, Travis county.

First Ann. Rept. Geol. Surv. of Texas, 1889, pp. 103-141. Austin, 1890.

Contents: Synopsis. Introduction. Upper, or Black Prairie series.—Geologic structure of the Black Prairie region; Lower Cross Timber sands; Eagle Ford clay shales; White Rock or Austin-Dallas chalk; Exogyra ponderosa marls; Upper arenaceous, or glauconitic series. Lower, or Comanche series.—Trinity sands, or Upper Cross Timber division; The Fredericksburg division; Basal beds; Comanche Peak beds; Caprina chalk; The Washita division.—The Flagstones; The Upper Caprotina limestone, or Austin Marble; The Washita or Fort Worth limestone; The Exogyra Arietina Clays; The Shoal Creek limestone; The Denison beds. Stratigraphy of the Comanche series in general. Progress section. Disturbances of the strata. General economic features.

"The two series of rocks comprising the Cretaceous System occupy the area of the State known as the Black Prairie, the Grand Prairie, and the two Cross Timbers, and unstudied areas in the eastern and Trans-Pecos regions of the State.

"To these strata the State owes a large part of her agricultural and general prosperity, for they are the foundation of the rich black waxy and other calcareous soils of those regions.

"In addition to their agricultural features they are the most productive source of building material, while adjacent to the parting between them, extending the entire length of the State and dependent upon their stratigraphy, is a remarkable area of natural and artesian wells, as seen at Fort Worth, Austin, Waco, Taylor, San Marcos and elsewhere.

"That these formations are of great economic value to the State is also shown by the fact that they are the site of our principal inland cities, and the rich agricultural soils which surround them." Pp. 105-106.

220. ————————

The Eagle Flats Formation and the Basin of the Trans-Pecos Region of Texas. (Abstract.)

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, p. 242. 1890.

"The portion of Texas west of the Pecos river is described as a series of complicated mountain disturbances, accompanied by much faulting and

HILL, ROBERT T.

eruptive material. The largest portion of the area, however, consists of extensive flats lying between the mountains, which are shown to be almost recent lake beds drained of their waters, except in rare instances, where salt lakes still occupy limited portions of these basins. The Quaternary or later sediments of these former lakes are described as the Eagle Flats formation."

221. ——————, and DUMBLE, E. T.

The Igneous Rocks of Central Texas. (Abstract.)

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, p. 242. 1890.

"Pilot Knob, Travis county, Texas, is described as the type of an intermittent line of basaltic rocks often of columnar structure protruding through the Cretaceous limestones of Central Southern Texas from east of Austin to the Rio Grande. The age is shown to be Post-Eocene, and the name Shumard system is proposed for this hitherto unclassified eruptive topographic feature.

"These eruptives (?) extend a little north of east from the Rio Grande in the vicinity of Fort Clark to Austin, Texas. The isolated eruptive areas of Rockwall county, Texas, and Pike county, Arkansas, are in line with this system, and probably all are along a line of weakness in the earth's crust which has apparently existed in this region. The time of the eruption is shown to have been Post-Eocene."

222. ——————

The Geology of the Staked Plains of Texas, with a Description of the Staked Plains Formation. (Abstract.)

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, p. 243. 1890.

"The Staked Plains are shown to be an extensive mesa, which was an interior base level in late Tertiary or early Quaternary time. Its surface is covered by a fresh-water lacustral sediment, consisting of loam and gravel, for which the name of the Staked Plains formation is proposed."

223. ——————

The Geology of the Valley of the Upper Canadian from Tascosa, Texas, to Tucumcari Mountain, New Mexico, with Notes on the Age of the Same. (Abstract.)

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, p. 243. 1890.

"This valley is shown to have been a more ancient piece (of) erosion than that accomplished by the present river which flows through it. It is from forty to sixty miles wide and eight hundred feet beneath the ancient base level of the Staked Plains, and filled with a detrital deposit, for which the local name of the Terra Blanca formation is proposed."

224. HILL, ROBERT T.

A Classification of the Topographic Features of Texas, with Remarks upon the Areal Distribution of the Geologic Formations. (Abstract.)

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, pp. 243-244. 1890.

"The Texas region is described and its topographic features defined as a series of ancient base levels, striking approximately north and south, and limited by two orographic systems, the more ancient and northern one being the Ouachita system of Branner, in Arkansas and Indian Territory, and the southern the mountains of northern Mexico and the Trans-Pecos region of Texas. Certain conspicuous valleys of erosion are explained, and the progress of denudation described. The relation of this topographic classification to the cultural possibilities of the region, and to the distribution of the floras and faunas is also shown."

225. ——————

Occurrence of Goniolina in the Comanche Series of the Texas Cretaceous.

Amer. Jour. of Science, III, Vol. XL, pp. 64-65. New Haven, July, 1890.

"For several years I have been puzzled by a peculiar organism which occurs abundantly in the basal and medial beds of the Comanche series of the Texas Cretaceous. This organism is preserved in chalky beds, of whose lithologic character it partakes, and is about the size and shape of ordinary playing marbles used by boys, except that it is slightly elongated, and flattened at one end, where there is a circular depression resembling the point of attachment between a fruit and its stem. The surface is minutely pitted and reticulated."

When submitted to eminent paleontologists, it was pronounced an undetermined species of the genus Goniolina, D'Orbigny, but whether animal or vegetable was a matter of doubt. One wrote:

"The fossil you send belongs to a group which has puzzled paleontologists for many years, and has been referred to almost every obscure group of paleozoology and botany. They were named Goniolina by D'Orbigny, who put them among the Foraminifera. Dr. White has shown me a French publication by Dumortier in which a Jurassic species is referred to the *Crinoidea;* Zittel says that Saporta has decided that they are the fruit of *Pandanus,* or 'screw-pine.' My own opinion is that they are *fruit* of some kind, and Saporta's reference is the most likely to be correct. Yours should be Lower Cretaceous."

As it begins in the Colorado river section in the lowest fossiliferous horizon in the Fredericksburg and ranges through 450 feet to the base of the Comanche Peak chalk; as the beds are all deep-sea deposits; as there are no lignites or other traces of land debris; and as the associated molluscan forms are all of off-shore species, the conclusion is reached that this cannot be the fruit of land vegetation.

HILL, ROBERT T.

"Zittel refers the genus to the family Cornuspiridae, of the Foraminiferæ, and says that it is a Jurassic genus."

Its occurrence in the Comanche series of Texas is the first noted in America.

226. ——————

Exploration of the Indian Territory and the Medial Third of Red River.

Amer. Geologist, Vol. VI, pp. 252-253. Minneapolis, Oct., 1890.

A letter descriptive of a Reconnoissance in Northern Texas and Southern Indian Territory. "The problems studied were (1) the westward deflection of the two Cretaceous embayments of the Arkansas-Texas region, and (2) the geology of the interior region upon which the Cretaceous sediments were laid down, and from which they were derived." The following statement is of more than ordinary interest: "It is also evident that great disturbance has taken place even in Post-Cretacic times, for the Red river flows in a fault through Upper and Lower Cretacic rocks north of Denison with a northern downthrow of nearly a thousand feet."

227. ——————

The Texas Cretaceous.

Correspondence.

Amer. Geologist, Vol VI, pp. 253-254. Minneapolis, Oct., 1890.

The object of this letter was to correct a misleading sentence in a review of the Author's "Check list of the Cretaceous Fossils of Texas" (Amer. Geol., Vol. VI, p. 124), which reads: "The list proves evidently that all the Cretaceous strata in Texas are more recent than the English Gault." With reference to this, Professor Hill says: "Nowhere in the list do I commit myself to an opinion as to European equivalency, for I become more and more, each year, indisposed to correlate our Texan strata with those of Europe alone. I do believe in trans-oceanic correlation, when trans-oceanic faunas are the same, but, it has been utterly impossible heretofore to even have a basis of comparison, without such a list as I have endeavored to give."

228. ——————

Pilot Knob: A Marine Cretaceous Volcano, with Notes on its Petrography by J. F. Kemp. (See Kemp, J. F.)

Amer. Geologist, Vol. VI, pp. 286-294. Minneapolis, Nov., 1890.

This paper, illustrated with maps and figures, deals with "an interesting occurrence of ancient volcanic phenomena in the vicinity of Austin, Texas.

* * * * * * *

"Among the varied topographic features about Austin are some low rounded hills which, appearing above the horizon of the Black Prairie

HILL, ROBERT T.

seven miles southwest of the city, present a peculiar aspect. Upon closer study these hills are found to consist of several cusps of igneous rock rising from a circular depressed area of about 1,000 acres, and projecting through and above the chalky strata of the Black Prairie which surround it on every side. * * * The hills have an altitude of 750 feet above sea level, and 50 above the surrounding prairie.

"They are composed of a hard black rock, the exact lithologic constitution of which, as shown by Prof. Kemp in the accompanying article, is that of limburgite or nepheline basalt."

The region "between the basaltic hills and the chalky perimiter of the igneous area" is described, and the effect of the igneous outburst upon the chalky rock shown. The Structural Features throwing light upon the Age of Pilot Knob are discussed, and the relation of this igneous outcrop to others indicated. The conclusion reached is that "Pilot Knob is the neck of an ancient volcano which rose out of and deposited its debris in the deep water of the Upper Cretaceous sea."

229. ——————

Roads and the Material for their Construction in the Black Prairie Region of Texas.

Bulletin of the University of Texas, pp. 17-39; map. Austin, n. d. [1890?]

Synopsis: 1. The Black Prairie Region of Texas geographically defined. Its Geological Structure and Origin of its Soil. Extent and Agricultural Importance. Its fullest Development retarded by interrupted Traffic.

2. Roads and their Construction. Wagon Ways the most essential Highways. What constitutes a good Roadway. The Economic, Legislative, Engineering, and Geologic Aspect of Road Making considered. The special Problems of Road Making in the Black Prairie Region.

3. The Material for the construction of Roads in the Black Prairie Region. Basalt. Gravels—Plateau Gravel, River Gravel, Creek Gravel. Limestones—Chalks, Chalky Limestone, and Marble. Marls—Oolites and other Substances. General Conclusions on the Relative Value of these Materials.

230. ——————

Contributions to the Geology of the Southwest.

Amer. Geologist, Vol. VII, pp. 119-122. Minneapolis, Feb., 1891.

Contents: The Altitude of Mount Scott. A New Silurian Area of the United States. The Age of the Comanche Series. Cretaceous Inliers. A New Source of Artesian Water in Texas. "Llano Estacado," or "Staked Plains." The Dakota Sandstone in Arkansas.

"*A New Source of Artesian Water in Texas.* In the American Journal of Science for April, 1887, the writer published the preliminary announcement of the Fort Worth-Waco artesian area, which is now known to

HILL, ROBERT T.

extend from Denton to Del Rio, a distance of 500 miles, and to be one of the most prolific artesian areas in the world, several hundred wells and numerous rivers which have their origin in fault-springs like those at Del Rio and San Antonio showing no appreciable diminution of the supply which has its source in the Trinity sands at the base of the Comanche series. During the past two months, from the wells at Pottsboro and Dallas, I have discovered that the Dakota sands are also the source of another valuable artesian area, which, though not so extensive as the Fort Worth-Waco area, will prove of great economic value to Texas." Pp. 120-121.

231. ——————

Notes on the Geology of the Southwest.

Amer. Geologist, Vol. VII, pp. 254-255. Minneapolis, Apr., 1891.

Contents: Gold in the Indian Territory. The Mineral Resources of Texas.

Attention is called to the "many valuable materials" in Texas worthy of economic development: chalk, marl, greensands, gypsum, coal, building stone, etc.

While the State is rich in the rarer minerals they have proved of little quantity. This statement applies especially to Tin and Platinum.

232. ——————

The Comanche Series of the Texas-Arkansas Region.

Bulletin Amer. Geol. Soc., Vol. II, pp. 503-528. May, 1891.

Contents: Introductory Statement. Definition of Terranes: Constitution of the Comanche Series—The Trinity, or Basal Division, Separation. The Trinity Sands, The Glen Rose Beds.—The Fredericksburg or Comanche Peak Division, General Composition, The Paluxy Sands, The Gryphaea Rock and Walnut Clays, The Comanche Peak Chalk, The Caprina Limestone. The Goodland Limestone.—The Washita or Indian Territory Division. General Aspect, The Kiamitia Clays or Schloenbachia Beds, The Duck Creek Chalk, The Fort Worth Limestone, The Denison Beds. Variation in the Character of the Deposits. Subsidence recorded in the Comanche Series. Stratigraphical Value of Terranes. Topographic Expression of the Comanche Terranes. Age of the Comanche Series.

This paper was discussed by C. A. White, C. D. Walcott, and Cooper Curtice.

For Review, see Amer. Geol., Vol. VIII, p. 259.

233. ——————

Notes on the Geology of the Southwest.

Amer. Geologist, Vol. VII, pp. 366-370. Minneapolis, June, 1891.

Contents: Thickness of the Upper Cretaceous Marls. Foraminifera of the Texas Region. Recent Indian Work-Shops of Central Texas. The

HILL, ROBERT T.

Tertiary Basin of the Lower Rio Grande. The Age of the Strata at Marble Falls and Shinbone Ridge. Aeolian Deposits of Eddy county, New Mexico. Possible Uses of Lignite.

Part III of the Final Reports of the Artesian and Underflow

"It is impossible, owing to the softness and lack of good exposures, to measure by surface sections the thickness of the Upper Cretaceous beds in Central Texas. An artesian well at Thorndale, however, penetrated 2000 feet of the Glauconitic beds and Exogyra ponderosa marls."

The existence of Carboniferous rocks at Shinbone ridge, as previously announced, is verified by the determination of fossils such as Zaprentis, Productus and other typical Carboniferous species.

234. ——————

Preliminary Notes on the Topography and Geology of Northern Mexico and Southwest Texas, and New Mexico.

Amer. Geologist, Vol. VIII, pp. 133-141; 2 cuts. Minneapolis, Sept., 1891.

Contents: Geographic Extent of the Basin Region. The Mountains. The Plain. The Lomas. The Conglomerate Terrace. Geologic Structure of the Region. The Main Mass of Mountain or Sierra Grande. The Sierra Chiquita or Hog Backs. The Lomitos or Foot Hills. The Formation of the Plain. The Valley Conglomerate or Terraces. The Basaltic or Volcanic Mesas.

"The topographic and geologic features of northern Mexico, and the Trans-Pecos region of Texas and New Mexico have been for several years a subject of profound interest to the writer, who, notwithstanding much study, involving thousands of miles of travel, still feels that he can contribute only a few data concerning this vast region, and that the main facts and details of its structure are still unraveled, especially those relating to orographic and igneous geology, and he presents the accompanying description of a small but typical portion of the area, with the hope that it may be of some assistance to those who are more competent to discuss as a whole the grander orographic features of our continent." P. 133.

235. ——————

On the Occurrence of Artesian and other Underground Waters in Texas, Eastern New Mexico, and Indian Territory, west of the Ninety-seventh Meridian.

Investigations, pp. 41-166, with numerous maps and illustrations. Senate Ex. Document 41, Pt. 3, 52d Cong., 1st Sess. Washington, May, 1892.

Contents.—Introduction: Letter to Chief Geologist. I. The Occurrence and availability of underground water: Influence of Topography upon distribution of underground water; Water conditions most favorable in later (newer rock sheets). II. General Outline of the Texas-New

HILL, ROBERT T.

Mexican region: The eastward division of the coastward incline; The Mountain systems; Remnantal plains of the Llano Estacado type; The plateau region; The basin plains of the Great Basin and Mexican Plateau region. III. Artesian conditions and structure of the eastern division of the coastward incline: The coastal prairie; The Washington or Fayette prairies; The East Texas forest region; The plateau gravel; The river terraces; The Cretaceous prairies, including the cross-timber regions; The Main Black Prairie region; The northern division; The Austin-Dallas chalk, The Eagle Ford prairies, the Lower Cross Timbers, Geological substructure of the Black Prairies. The Grand Prairie region, including the Upper Cross Timbers—general outline and comparison with the Black Prairies: The Indian Territory division; The Central or Fort Worth division; The Southern or Edwards Plateau division; The Stockton division; The altitudes of the Grand Prairie. Geological Structure of the Cretaceous Grand Prairie: The Trinity division; The Trinity or Upper Cross Timber sands; The Glen Rose or Alternating beds; The Paluxy sands. The Comanche Peak division or impervious beds; The Gryphaea rock and Walnut clays; The Comanche Peak chalk; The Caprina limestone; The Washita division. Topographic Expression of the Comanche series: Water conditions of the Black and Grand prairies; The rivers of the Grand Prairie; The Mammoth Springs of the San Antonio system, or natural artesian wells; The artesian waters of the Black and Grand prairies; Availability of the water sheets of the Black and Grand Prairies; The water-bearing strata; The availability of the water-bearing sheets; The Dallas-Pottsboro Group or wells of the Lower Cross Timber flow; Extent and limitations of the area. Wells of the Fort Worth-Waco system: The shallower wells of the Paluxy flow; The deeper wells of the Trinity flow (Fort Worth-Waco); Development at Fort Worth and Waco; The wells of the Glen Rose Group; Five hundred-foot wells of the Morgan Group; One thousand-foot wells of the Fort Worth-McGregor Group; Deep wells of the Waco-Dallas Group; Artesian failures in Grand and Black Prairie regions; Conclusions, etc., of artesian conditions in Grand and Black Prairie Regions; Artesian conditions south of the Colorado. IV. Water conditions of the Rio Grande embayment. V. The Water conditions of the central denuded region. VI. The Red Beds or Concho-Abilene country: Extent and conditions of the Red Beds country; The Texas-Oklahoma division; The Pecos-Canadian division. VII. Water conditions of the Llano Estacado region: Extent and structure; The great water-bearing cap-sheet, or Llano Formation; Artesian possibilities of the Llano Estacado. VIII. Water conditions of the Trans-Pecos Basin region. IX. Water conditions of the mountain region: The Raton-Las Vegas or plateau region; The Malpais or volcanic regions of New Mexico. X. Water conditions of Indian Territory, including Oklahoma: Water conditions of the hard limestone regions and other exceptional areas; Springs of the Washita and Arbuckle Mountains.

"The region covered is so vast and embraces so many diverse conditions influencing the water supply that I have been able only to treat it most briefly. I feel, however, that in the accompanying pages I have at least outlined the underlying principles of the water supply and pointed out their availability.

"The region assigned the writer for investigation comprised Indian Ter-

HILL, ROBERT T.

ritory (including Oklahoma), Texas, and New Mexico west of the ninety-seventh meridian and east of the Rocky Mountains, including over 300,000 square miles. This area is such a vast extent that it was impossible to traverse it thoroughly, even in a rapid manner, in the time allotted to the work. The writer, however, has fortunately spent many years in its previous study, but still feels that this report can only be considered, with the exception of the Grand Prairie region, as a preliminary outline of the water conditions.

"The area has been so little studied by geographers and geologists that much time had to be devoted to tracing out and classifying its elementary geographic features as a fundamental step to the geological and economic studies dependent thereon. Even the western limit of the investigation, as defined in the organization of the work, is still problematical, for the Rocky Mountains proper cease to be a clearly defined feature south of the thirty-third degree of latitude, and are succeeded by an undefined system of unconnected mountain blocks and plains which have not yet been satisfactorily classified.

"The reader of these pages should remember that the regions discussed are radically different in most natural aspects from the older inhabited portion of the United States. It is far more different from New England than is Japan. It has more points in common with Europe than with the great Mississippi Valley. The chalk lands and downs of Texas are more related to France than to the rocks of the adjacent Arkansas and Missouri States. This region of Texas, embracing nearly a third of the whole area of the artesian investigation, has more diverse geologic features than most of the remainder, which necessitates a disproportionate amount of consideration.

"The writer has endeavored to give only the laws of the occurrence and distribution of water, leaving to the engineers the discussion of its utilization. Neither is it within the province of this investigation to enter into an elaborate discussion of the minute geologic structure of this immense area, but in order to comprehend its water conditions it is necessary that such features be briefly described." Introduction, p. 47.

Noticed in the Amer. Jour. of Science, III, Vol. XLIV, p. 333, Oct., 1892.

236. ————

The Geologic Evolution of the Non-Mountainous Topography of the Texas Region. An Introduction to the Study of the Great Plains.

Amer. Geologist, Vol. X, pp. 105-115. Minneapolis, Aug., 1892.

Synopsis: Texas, east of the Pecos, is a vast series of plains, characterized by sub-horizontal structure, the most extensive terranes of which are Neozoic. The "Staked Plains" may be viewed as a continuation of the Great Plains, and are composed of Mesozoic strata. The plains of the eastern border of the State are a continuation of the Atlantic coastal plain. Each is characterized by its own fauna, flora, etc. A section from Las Vegas, N. M., to Galveston will give the details of deposition and degradation of the region. The only formations immediately bearing upon the

HILL, ROBERT T.

origin of the plains are Neozoic, the product of alternate subsidence and elevation. During these time-intervals the process of land degradation, sedimentation, and climate so varied as to produce the present differences in the composition of formations, soils, drainage growth, and topography. Review of our limited knowledge of the topographic features at the close of Paleozoic time. Post-Paleozoic land in the form of an isthmus or a peninsular extended through the heart of Texas, and on its western shore the "Red Beds" were laid down. The Paleozoic rocks of Central Texas are exposed in two areas, separated by Mesozoic rocks which form the divide between the Brazos and Colorado rivers. In the northern area the rocks are Carboniferous-Permian; in the southern they are exposed successively down to the Algonkian. The Archaean and Paleozoic formations were completely covered by Mesozoic deposits and now occur in a valley of erosion surrounded on every side by horizontal scarps of the Cretaceous. The north and south Paleozoic rocks are an important factor in the evolution of the topography of the plains, as it partially outlined the existing surface features. It was a land barrier after the close of the Carboniferous. Subsidence began with the Lower Cretaceous. During the invasion of the sea the Comanche Series were laid down. Oceanic waters covered all of Texas, West Indies, etc. At the close of the Comanche there was an uplift. Again there was a loading of the coastal plain and the Upper Cretaceous was deposited.

During the subsidence the sea advanced interiorly, and the Texan and Great Plains regions, including much of the Rocky Mountain region, were buried beneath 2,000 feet of sediment. At the close of the Cretaceous another uplift took place, followed by the deposition and subsidence of the Eocene. "It is not known whether at the close of the Eocene there was any important event, such as the elevation or subsidence of the coastal plain. We have knowledge of only the basement history of the marine Eocene. Its upper contacts or gradation have never been studied or presented." The condition of the coastal region during the Mio-Pliocene is obscure. An important question is raised concerning the Llano Estacado formation whether it was laid down at marine or lacustral base-level. The author has been unable to find corroborative evidence of the lacustral theory. The evidence points to the identity in origin of certain coast deposits with those of the Great Plains.

During the Llano Estacado or Mio-Pliocene epoch the great fault line extending from Austin to Del Rio was developed. Later, in the Appomattox epoch, the shore line crossed from Texarkana, via Austin and San Antonio, west of Eagle Pass to the Rio Grande. Two river systems developed before this epoch remained; the Canadian and the Pecos represent one, the Colorado, Brazos and the Red rivers the other. At the culmination of the Appomattox a third system was developed, represented by the San Gabriel, Lampasas, Leon, Bosque, etc. The Columbian Epoch of the Pleistocene. The upward movement of the land at its close. Review of the present condition of the river systems; their drainage and denudation. The part played by the ancient Paleozoic floor. The plains of Texas are the product of oscillation, their topography of etching "by a series of consequent autogenetic drainage systems." The relation of denudation to the consolida-

HILL, ROBERT T.

tion of the rocks. Faults and Joints. Wind erosion. The solution of limestone and the formation of "tepetate."

237. ————

W. M. Harvey.

Amer. Geologist, Vol. X, pp. 328-329. Minneapolis, Nov., 1892.

An obituary notice of Mr. W. M. Harvey, of Glen Rose, Texas, who had discovered and collected much valuable material bearing upon the determination of the great Lower Cretaceous system in this country. "Through his patience as a collector, many important results were secured in the vicinity of Glen Rose, including a locality where marine mollusca of the Trinity formation * * * were associated with the Potomac flora of the north Atlantic States, and, above all, with the first determinable fossil vertebrates from those beds, including crocodile and fish remains."

238. ————

The Deep Artesian Boring at Galveston, Texas.

Amer. Jour. of Science, III, Vol. XLIV, pp. 406-409. New Haven, Nov., 1892.

Location of Galveston. Nearly the entire depth of the well below the sea-level. Section by Mr. Byrnes, the contractor (Eng. News, Aug. 2, 1892), covering a depth of 2863 feet. Provisional interpretation: Formations represented—Coast Prairie Beds (Pleistocene); Fayette Sands of Penrose (Pliocene-Miocene); Lignitic (Eocene). Last two hundred feet probably Eocene, but may be Upper Cretaceous. A brief discussion of these formations. "The total subsidence of the old Eocene shore line, according to this boring, has amounted to nearly three thousand feet."

239. ————

The Third Texas Report.

Correspondence.

Amer. Geologist, Vol. X, pp. 393-396. Minneapolis, Dec., 1892.

This correspondence is for the purpose of correcting some statements made in a Review of the Third Annual Report of the Geological Survey of Texas, published in the American Geologist for November, 1892 (Vol. X, pp. 311-316); and also to protest against the use of certain material in the Report itself without proper acknowledgment.

240. ————

Notes on the Texas-New Mexico Region.

Bulletin Geol. Soc. Amer., Vol. III, pp. 85-100. 1892.

Contents: Introductory. The Raton-Las Vegas Plateau. The Llano Estacado. The Edwards Plateau. The Washington Prairies. The Rio Grande Embayment. Basin Deposits of the Trans-Pecos Region: Char-

HILL, ROBERT T.

acter of the Basins; The Hueco-Organ Basin; The Mesilla Basin; The Jornado del Muerto Basin; The Eagle Flats Basin; Valley of the Salt Lake Basin; Basin Mimbres. Probable Basins of the Pecos Valley. The Volcanic Areas of eastern New Mexico.

"The present paper is intended to call attention to certain widely distributed features of the western Texas and eastern New Mexican region not hitherto described. The region treated embraces the country west of the longitude and south of the latitude of the Ouchita mountains (approximately corresponding with the thirty-fourth parallel). The features discussed are mostly non-mountainous, and of later age (Neocene) than the latest mountain uplifts." P. 85.

241. ———

The Coal Fields of Texas.

Mineral Resources of the U. S., 1891, pp. 326-328. Washington, 1893.

*Reprint, Manufacturers' Record, Baltimore, Jan. 13, 1893.

1. The Carboniferous coals of the Central Texas region. Outcrops of Coal Measures. The northernmost area. Counties. The southernmost area. Counties. The Texas area not a portion of the Missourian coal field. Extent of Texas coal field first made known by Dr. B. F. Shumard. Stratigraphy and succession of beds in the Brazos coal field published by Dr. C. A. Ashburner in the Trans. of the Amer. Inst. of Mining Engineers.

2. Cretaceous and Laramie coal field. Eagle Pass coal. Resemblance to coals of the Rocky Mountain region.

3. The Lignite beds of Texas. The chief deposits coincident with the Eocene Tertiary formation. Its general extent first outlined by Dr. B. F. Shumard. Dr. R. A. F. Penrose quoted on the "San Tomas coal mine" and the "Uses of lignite."

242. ———

Art. Clay Materials of the United States. Min. Resources of the United States. 1891.

Flints from the Chalk Formations (of Texas), pp. 500-501. Washington, 1893.

Segregations of black flint nodules in the "Caprina limestone" of Texas. Limestone with flints occur extensively throughout Central Texas. Counties enumerated. Most accessible locality in the west part of Austin on the Colorado, and in the numerous limestone quarries of this locality. Hundreds of tons of flint from the waste product. Importation and use of flint in clay grinding and porcelain manufacture.

243. ———

Art. Clay Materials of the United States. Min. Resources of the U. S. 1891.

(Clay Materials of Texas), pp. 518-522. Washington, 1893.

HILL, ROBERT T.

Conditions for occurrence of rock kaolin good. Decomposed outcrops of granite in Burnet, Llano, Gillespie and Mason counties. Kaolin in Edwards county. Tertiary and Cretaceous clays of Eastern Texas. Terrace alluvial and littoral deposits. Brick at Houston, Texarkana, Dallas, Waco and Austin. Clay at Dallas. Clay beds of the Miocene. R. A. F. Penrose quoted. Geological horizon of beds. Their possible use. Clays of the Eocene formation. Thickness of beds. Character of clay. Outcrops. Elgin brick. Calcarous clays of the Cretaceous. Deposits in the Eagle Ford shales. Exposures. Plastic clays at the base of the Lower Cretaceous (Trinity). Exposures. Clays of the Carboniferous and Permian. Clays of the Red Beds. Negative character of the Great Plains Tertiary. Clays in the Trans-Pecos mountainous region. The Benton clays. Texas Clays from the report of the State Geologist.

244. ——————

The Cretaceous Formations of Mexico and their Relations to North American Geographic Development.

Amer. Jour. of Science, III, Vol. XLV, pp. 307-324. New Haven, April, 1893.

(Age and Homotaxial Relations of the Comanche Series in Mexico and Texas, p. 313.)

The diverse opinions concerning the age of the Mexican Cretaceous. Felix and Lenk maintain the Neocomian age of the Tehuacan beds. Most Mexican geologists speak of the Hippurites limestone as probably Upper Cretaceous. Prof. Heilprin maintains the Upper Cretaceous age of both the Mexican and Texas Cretaceous. His mistake. Discussion.

"If those who doubt the Neocomian position of the faunas of basal half of the Comanche Series will compare my unpublished collections in the possession of the Texas Geological Survey and at my residence in Washington with the beautiful Cretaceous faunas of Portugal as illustrated by Choffat they will no longer doubt the homotaxial identity of the beds, but will be astonished at the wonderful and striking generic identity."

On p. 324 there is a tabulated statement of the "Known Position of the Cretaceous and related Formations in Mexico" in which their occurrences in the United States (Texas) is shown.

245. ——————

Paleontology of the Cretaceous Formations of Texas—The Invertebrate Paleontology of the Trinity Division.

Proceedings of the Biological Society of Washington, Vol. VIII, pp. 9-40, pls. i-viii. June 3, 1893.

Contents: I. Stratigraphic Divisions and Nomenclature of the Comanche Series. II. Position and Characteristics of the Trinity Division. The Basement Beds or Trinity Sands proper. The Glen Rose Beds. Aggregations of Species in Great Beds. Coquina Beds. The Oyster Agglomerate. The Vicarya Beds. Orbitulites Chalk. The Requienia ("Caprotina") Limestone. The Nerinæa Flags. III. Fossils of the Trinity Division

HILL, ROBERT T.

(List Given). IV. Age and Significance of the Trinity Division. V. Description of Species. Foraminifera: *Patellina texana* (Roemer). Echinodermata: *Epiaster* (?) sp. indet. Vermes: *Serpula paluxiensis* sp. nov. Molluscoidea: Genus indeterminate. Mollusca: *Anomia texana* sp. nov.; *Ostrea franklini* Coquand; *Ostrea franklini* var. *ragsdalei* var. nov.; *Pecten stantoni* sp. nov.; *Modiola branneri* sp. nov.; *Leda* (?) *harveyi* sp. nov.; *Cucullœa gratiota* Hill; *Cucullœa comanchensis* sp. nov.; *Cucullœa terminalis* Conrad; *Barbatia parva-missouriensis* Hill; *Trigonia stolleyi* sp. nov.; *Trigonia crenulata* Roemer; *Chione* (?) *decepta* sp. nov.; *Eriphyla pikensis* Hill; *Requienia texana* (?) (Roemer); *Monopleura marcida* and *M. pinguiscula* White; *Corbicula arkansaensis* Hill; *Cardium* (?) *servierense* Hill; *Proctocardia* sp. indet.; *Pholadomya knowltoni* sp. nov.; *Pholadomya lerchi* sp. nov.; *Pleuromya* (?) *henselli* sp. nov.; *Isocardia* (?) *medialis* (Conrad); *Natica* (?) *texana* Conrad; *Viviparus* (*Natica?*) *cossatotensis* Hill; *Cylindrites* (?) sp. indet.; *Buccinopsis* (?) *parryi* Conrad; *Tylostoma pedernalis* (Roemer); *Vicarya branneri* sp. nov.; *Nerinœa austinensis* Roemer; *Neritina* sp. indet.; *Neumayria walcotti* Hill; *Acanthoceras* (?) *justinœ* sp. nov. Arthopoda: *Cypridea texana* sp. nov. Plantæ: Undetermined species. ("Goniolina?" of author's previous writings.) VI plates.

"It has heretofore been impossible to present faunal studies of the paleontology of the various horizons of the Comanche Series owing to the fact that the fundamental problems concerning the sequence and relative importance of its subdivisions had not been presented until lately, although the identity of the series, as a whole, was made known in 1886. Prior to that time most of its fossils had been described by Shumard, Roemer and others, but it was supposed that the species all came from beds which were in some manner equivalents of the upper Cretaceous or the well known Meek and Hayden section. Since the writer ascertained that the Comanche Series was a distinct and lower Cretaceous formation he has spent several years in studying the subdivisions and their extent, in ascertaining the stratigraphic position of the fossils or faunas already described, and arriving at a rational system of nomenclature. These steps were necessary before the homotoxy of the series could be discussed." Pp. 9-10.

246. ——————

Tucumcari.

(Correspondence.)

Science, Vol. xxii, pp 23-25. July 14, 1893.

"The writer first visited this historic locality in 1887, before he had had opportunity to define the Denison beds at the top of his Lower Cretaceous section in Northern Texas, and fell into the error, which others have not escaped, of concluding, from the peculiar Jurassic-like *Gryphaea dilatata*, Marcou, the only fossils found upon that visit, that the beds were Jurassic, and so published his opinion.

"Later, however, after having had an opportunity to complete his study and arrangement of the stratigraphy of the Comanche series in Central Texas, he discovered in the Denison beds (Denison beds as originally defined

HILL, ROBERT T.

and used by writer. Not the Denison beds of Taff, as used in an entirely different meaning. Compare Bulletin of Geological Society of America, Vol. II, p. 591, and Third Annual Report of Texas State Geological Survey) of his Washita Division, certain features which led him to believe that his early diagnosis of the Tucumcari beds was erroneous, and that they were really closely allied in age to the Denison beds. Under this impression, which was communicated orally to all interested, he availed himself of the first opportunity to revisit Tucumcari, April 30, 1891. He then discovered in association with *G. dilatata* the list of additional species herewith given, and, at earliest opportunity, under date of May, 1892, published, in a general discussion of the region, the following revision of his previous conclusions, which was the first printed announcement of the Cretaceous age of the *G. dilatata* beds:—

"THE TRINITY SANDS AND RED BED REGIONS.

"The writer has twice visited the Mesa Tucumcari and found it a most interesting geological remnant of the former area of the Llano Estacado, The table or summit described by Capt. Simpson is covered with the typical Llano Estacado formation, identical in composition and formerly continuous with the sheet which covers the Llano proper, some 20 miles distant. Below this is a vertical escarpment of 50 feet or more of typical Dakota sandstone resting upon loose sands and clays, forming a slope identical in aspect and fossil remains with the Denison beds of the Washita Division, which have been eroded away from the 400 miles intervening between it and the main body of those beds at Denison, Texas. Beneath this is a large deposit of the typical Trinity sands *country* of (For "country of" read "consisting of"—a typographical error.) white pack sands, thin clay seams, and flagstones, while the base is composed of the typical vermillion sandy clays of the Red Beds."

Misquotation in the Third Annual Report of the (Texas) Geological Survey, and in *Science* of May 26, 1893, p. 283. Outline of the region and its broader problems in Bulletin of the Geological Society of America entitled "Notes on the Texas-New Mexico Region." Section of Tucumcari Mesa. List of Fossils. List of fossils published in the Texas Reports.

"Finally, the writer wishes to state that he is not prepared, nor does he desire, to write a final treatise on the Tucumcari, which can never be properly related until the atlas-sheets of the United States Geological Survey are completed for the region. Tucumcari is but a single station in the vast group of phenomena belonging to the deposition and degradation of the Las Vegas and Llano Estacado Plateaus and the Canadian Valley, and to be properly understood it would be necessary to write a treatise on the whole region. One thing is settled beyond all doubt in my mind, however, and that is that the *G. dilatata* beds of the region do not belong to the Jurassic, but are undoubtedly of Cretaceous age. On the other hand, it may also be safely assumed that the Gryphæa *dilatata*, Sow. of Marcou, is not the same as *G. pitcheri*, Morton, as has been asserted by many authors, nor does it occur in the Cretaceous beds of Central Texas, so far as the writer is aware. But this is a question which cannot be discussed intelligibly until a thorough revision of the Grypæas is made.

HILL, ROBERT T.

"In conclusion, permit me to say that there is not one trace of the Jurassic formation over the Texas region, as Mr. Marcou so positively affirms, and, furthermore, there is no evidence that it was ever there, the whole trend of the testimony being to show that that region was land during the Jurassic period."

247. ——————

The Paleontology of the Cretaceous Formations of Texas.—The Invertebrate Fossils of the Caprina Limestone Beds.

Proceedings of the Biological Society of Washington, Vol. VIII, pp. 97-108, pls. xii-xiii. July 20, 1893.

Contents: I. Stratigraphic Position of the Caprina Limestone Beds in the Comanche Series. II. Characteristic Fossils. (List of species from the Rudistes horizon at Austin, etc.) Chamidae, Rudistæ. III. Age of the Caprina Limestone Beds. IV. Description of Species: *Ostrea munsoni* sp. nov.; *Radiolites davidsoni*, sp. nov. Plates

"About midway in the column composing the Comanche series or Lower Cretaceous of Texas, and constituting the uppermost member of the Fredericksburg division (Comanche Peak group of Shumard in part), there is a peculiar group of strata known as the Caprina limestone of Shumard.

"Dr. Shumard placed the bed in the Upper Cretaceous, at the very top of the whole of the fifteen or more subdivisions of the two great formations of Texas, instead of in the middle of the lower series, where it belongs." Pp. 97-98.

The Caprina limestone is now known as the Edwards limestone, a geographic name having been substituted for Shumard's term. See Hill and Vaughan, "Geology of the Edwards Plateau," etc., 18th Ann. Rept. U. S. Geol. Survey, Pt. II, p. 227, note. 1898.

248. ——————

The Coal Fields of Texas.

Mineral Resources of the U. S., 1892, pp. 507-509. Washington, 1893.

No literature since the last report. Texas Geological Survey discontinued. Development of the Central Texas coal field has progressed in Parker and Erath counties. Cretaceous coal field in the vicinity of Eagle Pass has been further prospected. Interest in the utilization of Tertiary and Cretaceous lignites. Conclusions quoted from Report on Brown Coal and Lignite by E. T. Dumble, State Geologist (p. 230). Report does not deal with cost of production and manipulation. It has not been shown that lignites can enter seriously into competition with the true coals of the region, or that they can be profitably used except locally. One of the chief obstacles to their utilization is the large amount of water they contain.

249. ——————

Art. Clay Materials of the United States. Mineral Resources of the U. S. 1892.

(Clay Materials of Texas), pp. 735-737. Washington, 1893.

HILL, ROBERT T.

Mr. N. F. Drake quoted on the Carboniferous clays of the Colorado Coal Field (Fourth Ann. Rept. of the Geol. Surv. of Texas, Pt. I, p. 439).

Mr. W. Kennedy quoted on the brick clays in Grimes and Robertson counties (Fourth Ann. Rept. of the Geol. Surv. of Texas, Pt. I, pp. 30, 79). Vitrified Brick. Paleozoic shales.

250. ——————

Geology of Parts of Texas, Indian Territory and Arkansas adjacent to Red River.

Bulletin Geol. Soc. Amer., Vol. V, pp. 297-338; pl. 12-13; pl. 12. 1894.

Contents: Comprehensive Position of the Region geologically. Physiographic Features: Topography, Drainage; Forest Growth and its Relation to Geologic Structure. Geologic Formations and Succession. Typical Geologic Sections: Preston Section—Trinity Sands, Walnut Clays, Goodland Limestone, Beds of the Washita Division, Lower Cross Timber (or Dakota) Sands, Eagle Ford Shales, Austin Chalk, Review of the Section topographically. Paris Section—Ultima Thule Section—Antoine Section—Rockport Section. Extent and Topographic Expression of the Terranes. Fault Systems and their Influence on Topography and Areal Geology. Variation of Sedimentation away from Ouchita Shoreline. Washita Division of the Comanche Series: Relation to other Divisions, Extent of the Washita. Comparison of Austin and Denison Sections. Austin Section: Shoal Creek Limestone, Exogyra arietina Beds, Fort Worth Limestones. Denison Section: Kiamitia Clays, Duck Creek Chalk, Fort Worth Limestones, Denison Beds. General Remarks on the Sections. Western Shoreline of the Washita Division. Oscillations of Land and Sea recorded in the Region. Conclusions as to the Cretaceous Section.

On pp. 337-338 of this article will be found a list of papers to date, published by Professor Hill on the Geology of the Texas Region.

251. HILLEBRAND, W. F.

New Analyses of Uraninite.

Amer. Jour. of Science, III, Vol. XLII, pp. 390-393. New Haven, Nov., 1891.

Since the publication of a former paper on the occurrence of nitrogen in uraninite and on the composition of uraninite in general no advance has been made towards clearing up the mystery surrounding the composition of that mineral, although considerable work has been done in certain directions, some of which is of sufficient interest to be produced later in a separate publication. In addition, several analyses of uraninite have been made, the material being, in part from localities hitherto unrepresented by analytical data, and these form the subject of the present paper.

"A first glance sufficed to show that the specimens were not fresh, and that therefore analysis could throw no light on the ultimate composition of the mineral, but valuable data to be obtained as to the presence of or absence of nitrogen and of the rare earths furnished ample excuse for the work."

HILLEBRAND, W. F.

I. LLANO COUNTY, TEXAS.

	a HILLEBRAND.	*b* HIDDEN AND MACKENTOSH.
$U O_3$	44.17	46.75
$U O_2$	20.89	19.89
$Th O_2$	6.69	7.57
$Zr O_2$	0.34	
$Ce O_2$	0.34	
La group	2.36	
Y group	9.46[1]	11.22[4]
Ca O	0.32	
Pb O	10.08	10.16
$H_2 O$	1.48	2.54 (ign.)
N	0.54	
$Si O_2$	0.46[2]	
Insol	1.47[3]	1.22
$Fe_2 O_3$	0.14	0.58
	98.74	99.93
Sp. G	8.29	8.01

1. At. weight, 111.4. 2. From thorogummite. 3. Mainly fergusonite. 4. At. weight, 124.2.

"No. I*a* is a re-analysis of nivenite from Llano county, Texas, the material for which was kindly given by Mr. W. E. Hidden. It agrees in the main with the original analysis of this variety by Hidden and Mackentosh, which is reproduced under I*b*, and it confirms the presence of nitrogen, suspected but not proven by them. A small remnant of their original powdered sample gave me 0.52 per cent. of nitrogen. In *a* the earths appear in slightly greater total amount than in *b*, and they are more subdivided into groups and elements, which accounts fully for the difference between the atomic weights of the metals of the yttrium group of the two analyses. It was rendered certain by a second test that a group of earths whose sulphates are insoluble in potassium sulphate other than those of Th, Zr, and Ce is present. A very satisfactory turmeric paper reaction for zirconia was obtained in this analysis, as also in that next following, which would go to show that the hypothetical $Zr O_2$ of several of my earlier analyses was probably in fact zirconia. The cause of the considerable loss shown by the analysis is not known. It may be mentioned that nivenite is more soluble than any uraninite heretofore examined by me, not even excepting cleveite. One hour sufficed for complete decomposition in very dilute sulphuric acid (1 $H_2 SO_4$ to 6 $H_2 O$) at the temperature of boiling water."

Of the other specimens analysed, No. II is from Marietta, Greenville county, South Carolina; No. III from Villeneuve mica mine, Ottowa county, Province of Quebec, Canada, and No. IV from Johanngeorgenstadt, Saxony.

252. ————

See Hidden, W. E. On Mackentoshite, a new thorium and uranium mineral, with analyses by W. F. Hillebrand.

Amer. Jour. of Science, III, Vol. XLVI, pp. 98-103. New Haven, Aug., 1893.

253. HILLEBRAND, W. F.

See Hidden, W. E. and Hillebrand, W. F. Description of Rowlandite.

Amer. Jour. of Science, III, Vol. XLVI, pp. 208-212. New Haven, Sept., 1893.

254. HINTON, RICHARD J.

A Report on the Preliminary Investigation to determine the Proper Location of Artesian Wells within the Area of the Ninety-seventh Meridian and east of the Foot-hills of the Rocky Mountains.

A Report of the Special Agent in Charge.

51st Congress, 1st Session, Senate Ex. Doc. No. 222. Washington, 1890.

(A Valuable Report from Western Texas. P. 15.)

A brief summary of the Report made by Field Agent F. E. Roesler. See Title No. 344.

255. HITCHCOCK, CHARLES H.

Geological Map of the United States and Part of Canada. Compiled to illustrate the Scheme of Coloring and Nomenclature recommended by the International Geological Congress.

Trans. Amer. Inst. Mining Engineers, Vol. XV, pp. 465-488. 1887.

An explanation of the Map is given on the pages indicated. The Map itself is 17x27 inches, and printed in color. Texas is included with the other States.

256. HOWELL, EDWIN E.

Notice of two new Iron Meteorites from Hamilton County, Texas, and Puquios, Chili, S. A.

Amer. Jour. of Science, III, Vol. XL, pp. 223-226. New Haven, Sept., 1890.

The first mentioned specimen was secured from Dr. Edgar Everhart, of the University of Texas, who wrote that it was found in Erath county, but, upon further investigation, it appears that it really was found in the northern part of the adjoining county of Hamilton.

History of its discovery. Description of the Iron. Analysis by L. G. Eakins:

"Fe	86.54
Ni	12.77
Co	0.63
Cu	0.02
P	0.16
S	0.03
C	0.11
	100.26

Specific gravity, 7.95 at 27°."

257. HYATT, ALPHEUS.

Carboniferous Cephalopods.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 327-356. 37 figures. Austin, 1891.

Contents: Nautiloidea. Goniatitinae.

The following outline will better show the scope of this paper:

Nautiloidea: *Temnocheilus Conchiferous*, n. s.; *T. Forbesianus*, McC.; *T. latus*, M. and W.; *T. depressus*, n. s.; *T. crassus*, n. s.; *Metacoceras cavatiformis*, n. s.; *M. dubium*, n. s.; *M. Walcotti*, n. s.; *M. Hayi*, n. s.; *M. inconspicuum*, n. s.; *Tainoceras cavatum*, n. s. Domatoceras, n. g. *D. umbilicatum*, n. s. Asymtoceras. *A. Newloni*, n. s.; *Phacoceras Dumbli*, n. s. Ephippioceras. *E. divisum*, W. and St. J. Endolobus. *E. gibbosus*, n. s. Goniatitinae. Gastrioceras. *G. compressum*, n. s.

"The following descriptions, accompanied by figures in outline, were taken from a collection forwarded by Mr. E. T. Dumble, State Geologist of Texas, and other fossils which were in my possession as loans from the National Museum and various persons referred to in the text. These forms being extremely limited in their chronological distribution, and, therefore, very helpful in distinguishing the age of the rocks in which they are found, it was thought best to have them all published in one treatise. This proceeding also enabled the author to make more satisfactory comparisons, and as these comprise a larger number of species than has yet been got together in a single publication, it will be more satisfactory to working geologists." P. 329.

258. ——————

The Fauna of Tucumcari.

Correspondence.

Amer. Geologist. Vol. XI, p. 281. Minneapolis, April, 1893.

"In an article in your March number, p. 213, 'Remarks on a part of the review of the Third Texas Report,' by Prof. Jules Marcou, I have been quoted as having said 'the fauna (meaning that of the Tucumcari region) is an upper Jurassic fauna.' This quotation is correct, but as stated by Professor Marcou, it was a verbal opinion given in 1889. I do not see why this should be considered of any value, but since it has been twice quoted * * * it is only proper to state that I do not at present consider myself qualified to give any opinion upon this question."

259. ——————

Carboniferous Cephalopods. Second Paper.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892. Pt. II, pp. 377-474. 35 cuts; plates xlvi-xlvii, inclusive. Austin, 1893.

Contents: Introduction—Explanation of Diagrams: Table I. Lettering of Diagrams to illustrate Descriptive Terms. Table II. Ontogenetic Terms. Table III. Summary of Terms. Tainoceratidae—Temnocheilus. *T. conchiferus; T. coxanus.* Foordiceras—Group of Goliathum; Group of

HYATT, ALPHEUS.

Transitorium. Metacoceras. *M. walcotti; M. cavatiformis.* Tainoceras. *T. cavatum; T. duttoni; T. quadrangulum.* Trigonoceratidae—Trigonoceras. Coelonautilus (pars), Foord,—Trematoceras; Stroboceras; Aphelecceras. Subclymenia; Diorugoceras. Triboloceratidae—Triboloceras. Vestinautilus, Ryckholt,—Coelonautilus, Foord, pars; Planetoceras; Stearoceras. *S. gibbosum.* Rineceratidae—Rineceras; Lispoceras. *L. trivolve; L. rotundum.* Thrincoceras. *T. depressum; T. kentuckiense.* Discitoceras; Leuroceras; Phacoceras. Koninckioceratidae—Koninckioceras; Domatoceras. *D. Simplex; D. militarium.* Stenopoceras. Coloceratidae—Coloceras. *C. globulare.* Solenocheilidae—Aipoceras; Oncodoceras; Asymptoceras; Solenocheilus. *S. kentuckiensis; S. collectus.* Eudoceratidae—Endolobus; Lophroceras. Goniatitinae—*Glyphioceras cumminsi; G. incisum. Gastrioceras entogonum? Paralegoceras. P. iowense.*

"The description of the fossils of the Geological Survey of Texas, in consequence of the numerous forms collected, and their importance to the geologic history of the Carboniferous in this country, has led me to give a fuller history of the series than in the first paper with the same title as this, which was published in the Second Annual Report of the Survey." P. 379.

260. JERMY, GUSTAV.

[Report.]

Reports of Geologists for Southern Texas.

Texas Geol. and Min. Surv. First Rept. of Progress, 1888, pp. 61-64. Austin, 1889.

Contents: Topography. Geology: Paleozoic, Jurassic, Cretaceous, Tertiary, The Quaternary Formation, Eruptive Rocks. Economic Products. Useful Rocks and Minerals: Iron, Building stone, Lignite, Mineral Waters and Artesian Wells, Petroleum.

The area of which this report treats embraces ten counties, viz: Gillespie, Kerr, Kendall, Bexar, Blanco, Comal, Wilson, Guadalupe, Gonzales, and Caldwell, situated between the Colorado and Nueces rivers.

261. JOHNSON, LAWRENCE C.

The Iron Regions of Northern Louisiana and Eastern Texas.

House Ex. Doc. No. 195, 50th Cong., 1st Session, pp. 54; 1 Map. Washington, 1888.

Contents: Letter of the Secretary of the Interior. Letter of the Director of the Geological Survey. Introduction. Stratigraphy of Northeastern Texas and Northwestern Louisiana. Quaternary—The Orange Sand, The Grand Gulf Series. Tertiary—The White Limestone, The Mansfield Series, The Claiborne Series, The Lignitic Series. The Cretaceous Islands. The Iron Regions. Varieties of Iron Ore—Nodular, Lacustrine, Impregnations. Occurrence of Iron Ore in Texas—Anderson county, Henderson county, Smith county, Cherokee county, Rusk county, Harrison county, Marion county. Occurrences of Iron Ores in Louisiana—Bossier Parish, Webster Parish, Claiborne Parish, Union Parish, Ouachita Parish, Lincoln

JOHNSON, LAWRENCE C.

Parish, Jackson Parish, Bienville Parish, Winn Parish, De Sota Parish, Caddo Parish. Other minerals of the Iron Regions—Gold and Silver, Lead, Coal, Limestone, Clays, "Kaolin," Quartzites. Acknowledgments—Louisiana, Texas.

262. JONES, JOHN F.

Production of Coal West of the Mississippi River.

(Abstract of a Census Report.)

[Coal in Texas.]

Engineering and Mining Journal, Vol. 51, p. 407. N. Y., Apr. 4, 1891.

"The principal body of bituminous coal in Texas lies in the northern central portion of the State, extending southwest from the Red river in Montague county, to the Colorado river. This basin is a continuation of the great Fourth or Western field, of which it forms the southern extremity. It is said to underlie the whole or portions of 25 counties, and embraces an area of 12,000 square miles."

Worked in 1889 by the Texas and Pacific Coal Co. in Erath county.

"The field next in importance * * * lies along the Rio Grande, underlying the Webb, Dimmit, Zavala, Uvalde, Medina and Maverick counties, known as the Nueces coal field, and embraces about 3700 square miles." The principal developments are at Santa Tomas and Eagle Pass.

"An extended area, bounded by lines drawn from Clarksburg [Clarksville], in Red river county, southwesterly to the Rio Grande, and thence northeast to the Sabine River, in Sabine county, is said to contain important deposits of lignite." P. 407.

263. J. T. W.

Note on the Geology of Hardeman County.*

Geol. and Scientific Bulletin, Vol. 1. Houston, Jan., 1889.

"References to Cretaceous and Quaternary formations." From Darton's Record of N. A. Geol. for 1887, etc., Bull. U. S. Geol. Surv., No. 75, p. 98.

263a. KAIN, C. HENRY.

(Report on a nearly White [Diatomaceous] Earth, very light in Weight, from Crosby County, Texas.)

See titles Nos. 6 and 440.

264. KEMP, J. F.

See Hill, R. T., Pilot Knob: A Marine Cretaceous Volcano, with Notes on its Petrography, by J. F. Kemp.

Amer. Geologist, Vol. VI, pp. 286-294. Minneapolis, Nov., 1890.

Notes on a Nepheline Basalt, from Pilot Knob, Texas, by J. F. Kemp, pp. 292-294.

265. KENNEDY, W.

Report of.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. ciii-cv. Austin, 1891.

Administrative Report. The work done was largely that assigned him in the letter of instructions from the State Geologist: "The work to which you are assigned for the present is the continuation of the mapping of the iron ore deposits of Eastern Texas. You will, therefore, proceed to Cass county, which is now partially finished, and complete it. Then make reconnoissance of Bowie to determine amount of iron in that county.

"In addition to the mapping of these ores, you will make such observations in the clays and lignites as you are able to do, thus preparing yourself to take up their study in detail as soon as the present work is completed."

The proposed reconnoissance into Bowie county was abandoned, as it was soon ascertained "that the existence of iron ore in that county was problematic." The iron ores of Harrison county were also examined and mapped, and the clay and lignite exposures visited, after which a few days were spent in the vicinity of Jefferson, Marion county, investigating clay and green sand marl deposits. General geologic and topographic notes were taken in connection with all the work.

266. ————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter I. Cass County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 65-95. Austin, 1891.

Contents: Preliminary notes. Topography. Stratigraphy.

Iron ores: I. Laminated Ores. II. Geode, or Nodular Concretionary, Ores. III. Conglomerate Ores. Table showing analyses. Discussion of Analyses of Cass county Iron Ores. Ferruginous Sandstone. Clays: 1, Pottery Clay; 2, Fire Clays; 3, Brick Clay. Building Stone. Mineral Springs. Lignite. Greensand Marls. Timber. Water Supply.

"The iron ore region of Cass county extends in a general though somewhat irregular course from the southwest end of the county to the northeast. In the southwest it covers a roughly shaped parallelogram extending along the lower half of the Morris county line southward to the Marion county line, thence eastward along the northern boundary of Marion county for several miles to near the crossing of the Texas and Pacific Railway. From the northeast corner of this parallelogram a long, narrow, irregularly shaped tongue or ridge extends northeasterly to near the town of Atlanta, when it widens out into a rude sort of a triangle, having its northern side somewhat parallel to the course of the Sulphur Fork of the Red River." P. 65.

267. KENNEDY, W.

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter II. Marion County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 96-114. Austin, 1891.

Contents: Introductory. Geography and Topography. Economic materials: Iron Ores, Timber, Clays, (Analyses of Clays). Moulding Sands. Greensand marls. Lignites.

"The iron ore deposits of Marion county belong to the great belt of ores lying in a generally northeast and southwest direction through the various counties composing the eastern division of the State.

"These ores are chiefly of the geode, or nodular concretionary variety of limonite, although the other varieties, laminated and conglomerate, are present in considerable quantities." P. 100.

268. ——————

Reports of the Iron Ore District of East Texas. Part III. Description of Counties. Chapter III. Harrison County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 115-160. Austin, 1891.

Contents: The Iron Ore Region. Topography. Stratigraphy. Iron Ores: 1, Laminated Ore; 2, Geode or Nodular Concretionary Ore; 3, Conglomerate Ore. Analyses of Iron Ores. Ferruginous Sandstones. Clays: 1, Brick Clays or Brick Earths; 2, Fire Clays; 3, Pottery Clays; 4, Miscellaneous Clays. Building Stone. Greensand Marl. Lignite. Water Supply. Mineral Springs. Timber.

"The ore region of Harrison county appears to form the remnant of an extensive plateau, which extended from the northern part of the State southward. This plateau-like region is cut off somewhat abruptly towards the south and northeast portions of the county, and also shows that a considerable amount of erosion has taken place in the northern part of the county. All that now remains is the narrow flat-topped ridge extending from the western boundary of the county eastward to about seven or eight miles north and east of the town of Marshall." P. 117.

269. ——————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter IV. Gregg County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 161-172. Austin, 1891.

Contents: Preliminary Report on the Iron Ore Districts. Stratigraphy. Iron Ores: 1. Laminated Ore. 2. Geode or Nodular Concretionary Ore. 3. Conglomerate Ores. The Iron Ore Bearing Regions. Lignites. Building Stones. Clays. Soils. Timber.

"The few cursory notes taken exhibit a similarity of structure with the other counties lying to the east and northeast. The higher grounds of the county are covered with a heterogeneous mixture of orange-red, yellow,

KENNEDY, W.

and brown sands, fragments of ferruginous sandstones of irregular sizes and forms, and laminated iron ore with nodules of concretionary iron ore, many of which are broken into small fragments, and occasional boulders of conglomerate ore. The lower, or grounds lying intermediate between the ridges and the river bottom sands, are covered by a yellowish or brownish colored sandy loam, containing occasional nodules of iron ore, and the river bottom lands are chiefly made up of a silt or fine gray colored sand." P. 161.

"The iron ores of Gregg county belong to the same classes of ores—the laminated, nodular or concretionary, and the conglomerate ores—found scattered throughout the other counties of Eastern Texas." P. 164.

270. ——————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter V. Morris, Upshur, Wood, Van Zandt and Henderson Counties.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 173-203. Austin, 1891.

Contents: (Introduction.) Morris County. Iron Ores. Analyses of Iron Ores. Greensand Marls. Lignites. Clays. Upshur County. Analyses of Iron Ores. Wood County. Analyses of Iron Ores. Van Zandt County. Analyses of Iron Ores. Henderson County. Iron Ores. Analyses of Iron Ores. Building Stone. Clays: 1. Brick Clay. 2. Refactory Clays. 3. Pottery Clays. 4. Miscellaneous Clays. Analyses. The Clay Industry. Glass Sand. Lignites. Analyses. Timber.

"The counties of Morris, Upshur, Wood, Van Zandt and Henderson mark the northwestern limit of the iron region of East Texas." P. 173.

The iron ore areas in these counties are as follows:

1.	Morris county	15 square miles.
2.	Upshur county	10 square miles.
3.	Wood county	25 square miles.
4.	Van Zandt county	1 square mile.
5.	Henderson county	19 square miles.
	Total	70 square miles.

271. ——————

Report of (for 1891).

Geol. Surv. of Texas. Second Report of Progress, 1891, pp. 55-69. Austin, 1892.

Contents: Introduction. Geology: Recent; Quaternary; Pliocene; Miocene; Eocene; Lower Eocene. Economic Geology: Salt; Lignite; Iron Ores; Greensand Marls; Building Stones; Infusorial Earth; Clays.

"The work of the Survey in East Texas during the season of 1891 was chiefly the determination of the different geological horizons found within that area. The examination of some of the lignite deposits of Wood county and a complete detailed examination and survey of Houston county were also made during the season." P. 55.

272. KENNEDY, W.

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. lviii-lix. Austin, 1892.

Administrative Report. The work assigned by the State Geologist for the season of 1891 was "The making of a detailed section across the Post-Cretaceous deposits, from Terrell, in Kaufman county, via Mineola, Tyler, Lufkin, Corrigan, and Colmesneil, to the Gulf." Personnel of the Party. Upon the completion of the section additional work was assigned in Houston, Leon, and Robertson counties.

273. ——————

Houston County.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 3-40. 1 map; 1 fig. Austin, 1892.

Contents: Introductory. Geography and Topography: General Geology. Recent. Quaternary. Prairies: East and Tyler Prairies. Nevill's Prairie. Section of Tyler's Prairie. Section of Well on Nevill's Prairie. Mustang Prairie. Townsend Prairie. Drift. Miocene. Eocene. Murchison's Prairie. Economic Geology. Soils. (Analyses.) Light Gray or Yellowish Sandy Soil. The Dark Ashy Gray and Black Sandy Soil of the Prairies. The Dark, almost Black, and Brownish Black Soils of the Second Bottom Lands. Black and Brownish Black Sandy Clay Detrital Soils of the Areas subject to Overflow. The Brown or Red Soils. Southeastern Pine Prairie Soil. Crawfishy Soils. Greensand Marl. Iron Ores. Conglomerate Ores. Analyses. Laminated Ores. Clay Iron Stone. Lignites. Analyses. Localities. Building Stones. Clays. Timber. Water Supply.

"In the First Annual Report of the Geological Survey of Texas the only reference made to Houston county is a short notice of Cook's mountain (a high hill about two and a half miles west of Crockett), and an outcropping of shell-bearing sand about nine miles northeast of Crockett, on the old San Antonio road. In the Second Annual Report a more extended reference to the economic geology of this county is made in a preliminary report by Mr. E. T. Dumble, State Geologist, which is taken for the most part from the notes of Dr. Penrose and the report of Dr. R. H. Loughridge on Cotton Production of the Southern States, Tenth Census, Vol. 5.

"The present report is a description of the different features of the geology of the county from the standpoint of a much more detailed examination than has hitherto been made, during which it was ascertained that, in addition to the conglomerate iron ores already described, there are in the county also laminated and carbonate ores, and that the soils can be more properly presented under a difficult classification than that employed previously.

"In order to give the details as completely as desired, it has been found necessary to repeat and enlarge some of the work previously done." P. 5.

274. KENNEDY, W.

A Section from Terrell, Kaufman County, to Sabine Pass on the Gulf of Mexico.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 41-125, 3 figures. Austin, 1892.

Contents: Introductory. General Description.—Cretaceous. Eocene. 1. Basal or Wills Point Clays. 2. Lignitic Beds. 3. Marine Beds. The Mount Selman Series. Cook's Mountain Series. Section—Independence to Dial. Section—Rusk Penitentiary Hill. New Birmingham Section. Alto Region Section. Miocene. Lufkin or Angelina County Deposits. Fayette Sands. Fleming Beds. Pleistocene. Recent Deposits. Flood Plains of Rivers. Coastal Prairies or Plains. Lacustrine Formations. Details of Section.—1. From Terrell to Mineola, along the Texas and Pacific Railway. Grand Saline Region. From Grand Saline East to Mineola. Section of Well at Mineola. 2. Section from Mineola to Tyler along the Line of the International and Great Northern Railway. 3. Section from Tyler Southward, along the Line of the Tyler Southeastern Railway to Lufkin. Alto Section. From Alto southeast to Lufkin. 4. Section from the Angelina River, in Angelina county, South, to Corrigan Station, in Polk county, along the Line of the Houston East and West Texas Railway. 5. Section from Corrigan eastward to Colmesneil along the Line of the Trinity and Sabine Railway. 6. Section along the Southern Pacific Railway, from Rockland to Sabine Pass. Elevation of Stations and other Points along the Line of the Foregoing Section.

"In the First Annual Report of this Survey, Dr. Penrose, Geologist for East Texas, examined the rivers crossing the Tertiary deposits, and described the beds forming the sections shown along the Brazos, Colorado and Rio Grande. The uniform sequence of the various deposits, as exhibited in these river sections, led to the general inference that these, or deposits of a similar character, would be found extending clear across the State, from the Louisiana line on the east to the Rio Grande on the west.

"While these river sections are very valuable in many respects, they do not give a consecutive view of the whole of the beds constituting the various divisions of the Tertiary and newer strata in Southern and Eastern Texas. This is necessarily so, as the river banks have not, except at a few places, sufficient height to disclose any continuous order of succession of the beds. From the series of bluffs presented here and there, sometimes comparatively close together, but in many cases at long intervals apart on the three rivers mentioned, Dr. Penrose constructed the sections described by him in his preliminary report.

"With the twofold object of ascertaining the continuity of the deposits through the region east of Dr. Penrose's Brazos river section, and filling in the breaks necessarily left by him, in order to have as complete a section across the Tertiary areas of the State as could be obtained, I was instructed to run a line southeasterly across these areas from the border of the Cretaceous to the Gulf." P. 43.

"A very important consideration was the necessity of having some data as to the relative elevations of the different portions of the country through which the line extended. The levels of the lines of the various railways

KENNEDY, W.

running towards the coast in the most direct course conformable to the one the sections were wanted, offered the best data obtainable, and consequently the line of the section was begun on the border of the Cretaceous area three and a half miles east of Terrell, in Kaufman county, and carried along the following roads:

"1. From Terrell to Mineola, along the line of the Texas and Pacific Railway, in a general east by south course............46 miles.
2. From Mineola to Tyler, along the International and Great Northern Railway, southerly ....25 miles.
3. From Tyler, southwestward, through Smith, Cherokee and Angelina counties, to Lufkin, along the line of the Tyler Southeastern Railway ....90 miles.
4. From the Angelina river, south, along the Houston East and West Texas Railway, to Corrigan, in Polk county.........28 miles.
5. From Corrigan, east and southeast, along the Trinity and Sabine Railway, to Colmesneil, in Tyler county...........29 miles.
6. From Rockland, on the Neches river, south, along the Southern Pacific Railway, to Sabine Pass........................73 miles.

"This gives a total line of sections of 291 miles, in a course more or less in accordance with the general dip of the Tertiary and newer deposits of the State. In addition to the region in the immediate vicinity of the section, many other places were examined, and where possible have been brought into the line.

"The results arrived at may be briefly shown in the following table, giving the thickness of the different series of deposits.

* * * * * * *

"I. Recent Material .... 50 feet.

II. Quaternary—
1. Sands and gravels...................... 60 feet.
2. Clays including the Coast Clays.........100 feet. 160 feet.

III. Miocene (tentatively) Grand Gulf—
1. Blue limy clays and gray sands containing fossil palm wood, seen at Fleming, in Tyler county ....260 feet.
2. Fayette sands and sandstones...........490 feet.
3. Angelina county beds, laminated blue gypseous clays ....100 ? feet.
———— 850 feet.

IV. Eocene equivalent to Timber Belt beds—
1. Marine deposits, divided into—
a. Upper, or Cook's Mountain series ....390 feet.
b. Lower, or Mount Selman series ....260 feet.
———— 650 feet.
2. Lignitic deposits—
a. At Mineola ....600 feet.
b. At Grand Saline.......300 feet.
———— 900 feet.

KENNEDY, W.

3. Basal Clays, or Wills Point Clay	260 feet.	
		1810 feet.
V. Cretaceous, found in wells at Grand Saline		357 feet.

Pp. 44-45.

275. ——————

Report on Grimes, Brazos, and Robertson Counties. Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 3-84. 3 maps; 2 plates of sections. Austin, 1893.

Contents: Chapter I. Grimes County. Geography and Topography. Prairies. General Geology—(1) Recent. (2) Quaternary. Navasota Beds. (a) Upper Division. (b) Lower Division. Eocene. Piedmont Springs Area. Economic Geology—Soils. Alluvial Soil. Residual Soils. 1. The Grayish Brown and Dark Colored Calcareous Soils. 2. Gray Upland Sandy Soils. 3. Black Calcareous Soils. Wallace Prairie. Grimes Prairie. Navasota Prairie. Fuqua Prairie. Roan Prairie. Anderson Prairie. 4. Gray Sands of the Piedmont Springs Area. Building Stones. 1. Hard Semi-Quartzitic and Close-Grained Sandstones. 2. The Soft Thinly Bedded Calcareous Sandstones. 3. Upper Navasota Sandstones. Clay. Abrasive Materials. Lignite and Brown Coal. Timber. Water Supply. Artesian Water. Mineral Springs.

Chapter II. Brazos County. Geography and Topography. General Geology—Recent. Quaternary. Navasota Beds. Eocene. 1. Gray Sandstones. 2. Thinly Bedded Gray and Dark Gray Sandy Clays, Laminated and Thinly Bedded Sands and Clays, with Thin Beds of Lignite and Gypseous Clays. 3. Brown Ferruginous Greensand Marls, Greensands, and Greenish Blue Clays. Economic Geology—Soils. Alluvial. Residual Soils. Building Stones. Clays. Brown Coal. Timber. Water Supply. Artesian Wells. Navigable Streams. Mineral Springs.

Chapter III. Robertson County. Geography and Topography. General Geology—Recent. Quaternary. (1) Lower Deposits. (2) Upper Division. Tertiary. Basal Beds. Lignitic Beds. Marine Beds. Economic Geology—Soils. Building Stones. Clays. Brown Coal. Timber. Water Supply. Mineral Springs.

276. ——————

Texas Clays and their Origin. Science, Vol. xxii, pp. 297-300. Dec. 1, 1893.

Analyses of the clays of the Texas Tertiaries show that in most instances the soda to exceed the potash in ratios of 2 to 5 of soda to 1 of potash.

"As this excess varies in the different divisions, the difference generally increasing as we ascend in the beds, while at the same time the actual quantities of both decrease in the same ratio until the highest or coastal clays are reached, when the amounts of both are largely increased,

KENNEDY, W.

I have been led to the opinion that this peculiarity might be due to the origin of the materials forming these deposits, or that some clue to their source might be obtained by a study of this phenomenon."

Per cent. of potash and soda in clays of New Jersey, Ohio and Kentucky; in shales of Arkansas. Texas clays are sodic clays. Section of the underlying deposits of the Cretaceous age. Per cent. of potash and soda in these deposits.

"Clays naturally partake of the nature of the rocks from which they may have been derived, and the proportions of their constituents will in the same manner be in a ratio more or less in accordance with those of the parent rock, the variations being due to the solubility of the constituent and the number of changes to which it may have been subjected during the course of its transportation from the original locality to that in which we may find it. These changes are, however, sometimes extremely great, as, for instance, in the case of kaolin. Williams shows a kaolin in Arkansas, evidently derived from a syenite containing 5.48 potash and 5.96 soda, to have only 0.23 potash and 0.37 soda.

"Since, then, the Texas Tertiary clays appear to be sodic, where are we to look for their sources? Are they due to the destruction of the syenites of Arkansas or the basaltic outbreaks of which Pilot Knob is a representative, or must they be traced to a still more remote source among the eruptive and intrusive rocks of western or Central Texas through the media of the Cretaceous, Carboniferous and other stages found in Texas?"

The Tertiary deposits bear strong evidence of marine origin. Had this condition of deposition anything to do with the quantities of soda found in the beds? Discussion.

Description of the five divisions of the Texas Tertiary recognized by the State Survey: First, the basal beds or Will's Point clays; second, the lignite beds; third, the marine beds; fourth, the Yegua beds; fifth, the Fayette sands. The Fleming beds or Frio clays. The Coastal clays. "In the Tertiary clays of Texas the proportions of soda exceed the potash as 3.19 of soda to 1.18 of potash." The per cent. of potash and soda in the clays of the above formations.

"The question of the origin of these clays involves the existence of an extensive land area of deposits in which the alkalies were strongly represented, and, assuming the solubility of the two to be approximately similar (as a matter of fact the potash is slightly more soluble), one in which the soda was considerably more abundant than the potash. Again, throughout the deposits and interbedded with the clays we have heavy beds of sand, many of them almost pure quartz, and the greater portion of the clays themselves are highly siliceous. * * *

"It appears to me that the most probable immediate sources of the materials entering into the composition of these Tertiary deposits are the underlying Cretaceous beds for the lowermost or basal Tertiary, and a partial reworking of the older Tertiary with the Cretaceous materials for the upper or newer deposits."

A comparison of analyses of Tertiary and Cretaceous marls, and clays. The per cent. of lime in the Tertiary beds.

"It would thus appear that the structural conditions of the Basal beds

KENNEDY, W.

and the Fayette deposits, apart from any chemical evidence whatever, bears out the assumption of these two divisions being derived from the Cretaceous. If we accept Dr. Penrose's theory that the iron ores and glauconite of the marine beds are largely due to the destruction of the upper glauconitic division or the green-sand of the Cretaceous, and in this theory, from a long period of work among these beds, I am inclined to believe for several reasons—one of which being the close affinity chemically and otherwise of these beds. Then that will in a great measure dispose of the origin of the middle great division."

The conditions attendant upon the deposition of the Yegua clays and the Lignitic beds. Comparison of composition of lignitic clays and greensand marls.

"From this, then, it would appear that while the greater portions of these clays and sands are derived from Cretaceous materials, these have been mixed with a small quantity of ingredients belonging to some of the older formations through which the larger rivers ran; but the proportions of these older materials were so small as not to visibly affect the deposit as whole."

The opinion is advanced that neither the syenitic rocks of Arkansas nor the basaltic outbreaks of the Texas Cretaceous forms the source of the clays.

277. ————————.

The Age of the Iron Ores of East Texas.
Read before the Texas Academy of Science, Dec. 16, 1893.
Science, Vol. XXIII, pp. 22-25. Jan. 12, 1894.

The brown iron or limonite area of East Texas. Age of the deposits. Pumpelly assigns them to the Quaternary (Vol. 15, 10th Census). Probable reasons for this assignment. The work of Lawrence C. Johnson (Iron Ores of Northern Louisiana and Eastern Texas (House Ex. Doc. No. 195, 50th Cong., 1st Sess.) "This investigator appears to have been the first to recognize the existence of two divisions among the ores. These he separated, assigning the name of *nodular* ore to the one variety, and by the term *lacustrine* designated the other. This latter class he again divided into 'laminated' and 'buff crumbly' ores, according to their texture and physical appearance.

"While dividing the ores into these two great divisions, he at the same time placed them in different ages and under entirely different conditions. The nodular ore Mr. Johnson considered as belonging to the lignitic Tertiary, and we find him, after describing the ores of Marion county, saying: 'All this portion of the iron field, including Upshur, Camp, Morris, Marion, and Cass counties, is assigned to the great Lignitic of the Geological column.'" (Loc. cit., p. 34.)

"The laminated ore, or, as he described it, the lacustrine ore, Mr. Johnson appears to place in the Quaternary, as, after describing the conditions and modes of formation and deposition of such ores, he says: 'Such deposits were produced at various stages of the Quaternary history of the

KENNEDY, W.

regions under consideration, and some of them possibly during the Tertiary, and now that the strata are exposed to erosion, the hard insoluble limonites resist it more successfully than the unconsolidated sediments in which they occur; the softer rocks are, therefore, swept away, and the iron deposits remain upon elevated plateaus or buttes.' "

Mr. Johnson seems to have recognized the existence of extensive deposits of conglomerate ore. They belong to every age from the Eocene Tertiary to the recent.

"Dr. Penrose appears to agree with Johnson as to the age of the nodular ores being lignitic Tertiary, but the whole of the laminated ores he places, and rightly so, in the glauconitic or Claiborne Tertiary." Reference to Penrose, Rept. on Iron Ores, Geol. Surv. of Ark., Vol. I, for 1892, pp. 105-106.

"Numerous and careful examinations of these ore deposits throughout a great portion of east Texas, and particularly in Cass, Marion, Morris, Upshur and Harrison counties, the region in which the nodular ores are most extensively developed, have convinced me that these nodular ores do not belong to the lignitic stage of the Eocene, but rather that they are of the same age as, or probably a little newer than, or derived from, the laminated ores, which, according to Mr. G. D. Harris's determination of the fauna, are of lower Claiborne age."

Descriptions of the Lignitic and Glauconitic divisions.

"The general assumption of the nodular ores belonging to the lignitic by both Johnson and Penrose appears to have arisen from the idea held by both that the regions in which these ores occur in greatest abundance are altogether occupied by the clays and sands of that series. While it is true that the deposits of the lignitic stage are extensively developed in Cass, Marion and Upshur, and in a more limited way in Morris and Harrison counties, the marine stage is also represented, and widely spread, fragmentary deposits of altered greensand and glauconitic sandstones occur within the limits of these counties. These fragmentary deposits often cover several miles of territory, and their presence is always marked by the occurrence of nodular ore and a greater or less extent of laminated ore. This is usually in the form of very thin seams interstratified with the sands or occurs in a fragmentary condition scattered on the surface and mixed with the geodes of nodular ore.

"In Cass county the brownish-yellow altered greensands occur in association with both nodular and laminated ore at the Berry Crawford mine about a mile north of Atlanta. Here the section shows the nodular ore overlying the laminated ore and the underlying altered greensand resting directly upon the uppermost deposits of the lignitic series."

Other instances: In the neighborhood of Linden; at Cusseta. Occurrence of ores in the northwestern portion of Cass and eastern portion of Morris counties; in Marion and Harrison counties.

"It must, however, be admitted that as a general rule the heavier deposits of nodular ore occupy positions lying at relatively lower levels than the heavy deposits of laminated ores, and it also appears to be a settled condition that while extensive deposits of nodular ore overlie these beds, by far the most extensive and valuable of these nodular deposits

KENNEDY, W.

occupy positions between the isolated ridges, or what may be said to form the broken ends of the marine beds. This, however, is to be expected, if we are to assume that these geodes or nodules with their surrounding sands are the products, or the results of, erosion and consequent destruction of the glauconitic beds.

* * * * * * *

"In saying that none of these ore deposits occurs beneath the thinly stratified uppermost lignitic beds, I do not mean to affirm that no ore occurs within the lignitic series, but simply that none of the great deposits of nodular ore in East Texas which have hitherto been assigned to that series belongs to the lignitic. Small deposits of a nodular variety of ore, as well as clay iron-stone, do occur at several places within the lignitic beds. These, however, lie at considerable depths, and are found amongst the clays and sand of that series in well digging and other deep excavations. These are not all clay iron-stones nor carbonates, as has been asserted, and throughout the extensive areas of the eastern division of the State, in which the lignitic strata form the surface deposits, no ore of any kind has yet been found. The absence of these ores from the great lignitic areas of Limestone, Robertson, Smith, Harrison, Panola and other counties certainly appears remarkable if the nodular ores of Cass, Marion and others belong to these deposits.

"While the question of the age of the nodular ores may form a subject for discussion, no such doubt or difficulty besets the age of the laminated ores of the region. These are altogether from top to bottom of Tertiary age and of the lower Claiborne or marine Eocene wherever found."

Discussion of the origin and formation of the ores.

278. ———————

The Iron Ores of East Texas.

Trans. Amer. Inst. of Mining Eng., Vol. XXIV, pp. 258-288 and 862-863.

(Virginia Beach Meeting, February, 1894.)

Introductory: Mainly a history of the iron industry in Texas. Geology of the Ore-Region. Age of the Ore-Deposits. Classification of the Ores. Chemical Analyses of the Ores: Table I.—Analyses of Nodular Iron Ores. Table II.—Analyses of Laminated Ores. Table III.—Analyses of Iron Ores collected from East Texas, not included in Tables I and II. Table IV.—Analyses of Nodular Ores found in Cass, Marion, Upshur and Harrison counties. Table V.—Analyses of Laminated Ores from Morris, Harrison, Henderson, Anderson, Cherokee, and Rusk counties. Table VI.—Analyses of Pig-Iron made from East Texas Iron Ores. Tests of Tensile and Transverse Strengths of Cast-Iron made at the Lone Star Furnace. Table VII.—Analyses of Limonites from Alabama, Tennessee, Kentucky, Georgia, Sweden, Canada and Texas. Table VIII.—Comparative Partial Analysis, showing Metallic Iron, Phosphorus, and Phosphorus Ratio of Iron Ores from Southern Texas. Table IX.—Comparative Analyses of Pig-Iron. Table X.—Furnace Returns, Showing Average Yield of Iron in different Southern States. Methods and Cost of Mining and Production. Cost of production in the South as calculated by Carroll D. Wright

KENNEDY, W.

($10.755). Cost of manufacture in Texas ($12.01). Fuel. Flux and Markets.

Postcript in which the cost of iron is made $9.50 instead of $12.01, the decrease being largely due to the introduction of beehive ovens, which has cheapened the production of charcoal.

(See following title.)

279. ———————

Iron Ores of East Texas.

Abstract of paper read before American Institute of Mining Engineers.

Engineering and Mining Journal, Vol. 57, pp. 222-223, N. Y., March 10, 1894.

An extensive series of iron ore deposits in northeastern Texas occupy portions of nineteen counties. Out of an area of 10,000 square miles about 1,000 are covered with iron ore. Topography of the region is "compared to a great plain sloping gently to the southeast, cut into many flat topped, steep sided ridges and small tablelands by the numerous water courses which have their sources within the region, or find their way through it." A few hills reach an altitude of over 700 feet above the sea, "and their existence is due solely to the presence of an iron capping found either lying upon the surface or beneath a thin covering of yellowish-brown sand. This condition obtains mostly through the central and western portions." In the northeast and along the eastern boundary of the area the hills have been eroded and the country lies at a lower level.

"Only two of the great geological divisions are represented—the Quaternary or Pleistocene and the Eocene stage of the Tertiary."

The iron ores are classed as limonites. They are divided into three classes: Nodular, laminated and conglomerate. Each class is described.

The Texas ores have "fair average metallic contents, a medium admixture of silica and low percentages of both sulphur and phosphorus." Much of the iron produced is within the Bessemer limit. The ores are easily mined. The only fuel cheaply accessible is charcoal.

280. ———————

Geology of Jefferson County, Texas.

Amer. Geologist. Vol. XIII, pp. 268-275. Minneapolis, April, 1894.

Synopsis: Jefferson county lies in the extreme southeastern corner of the State. It is low and flat, a greater portion scarcely above tide. The altitude of Beaumont, the county seat, is 26 feet. The lower half of the county is marshy—suitable for rice growing—yet is used as a cattle range. In the northeastern part of the county the long-leaf pine, cypress, and magnolia are found. The climate is sub-tropical. Shell-mounds occur along the Neches. As to the geology: The region belongs to the Coastal Clay Regions of the Texas Geological Survey, and is classed by McGee as Columbia—an extension of the Port Hudson Clays of Louisiana. Discussion. Section of a well at Beaumont 413 feet deep. A boring for oil and gas.

KENNEDY, W.

The locality selected was a low mound five miles south of Beaumont. "Sour wells" along the base of the western side. Character of the waters. Reasons for locating the boring here. Depth 400 feet. Section. Hydrogen sulphide. Gas phenomenon shown by a smaller boring, 60 feet deep, near the larger. Emission of gas and mud. 300 feet west of the well, at the base of the mound, the same liquid, sandy mud was found, in excavating a pond, at the depth of 18 feet. In the bottom of the pond there were many lumps of brown oleaginous mud, and gas vents, with a thin coating of sulphur, as well as several small lumps of sulphur scattered through clayey sand. Description and peculiarities of the mound.

281. ——————

The Eocene Tertiary of Texas east of the Brazos River.

Proceedings of the Acad. of Nat. Sciences, Philadelphia. Pt. I, pp. 89-160. Jan.-Mar., 1895

References to the work of Hilgard (Geology of Mississippi) and to that of Smith and Johnson (Bull. No. 43, U. S. Geol. Surv.) east of the Mississippi. The work of Penrose, Harris and Kennedy in Texas. Comparison of the Alabama and Texas sections. Harris's general section of the Eocene Series of the Southern States.

Descriptions of the Frio Clays, Fayette Sands, Yegua Clays, Marine Beds, Lignitic Beds, and Basal Beds or Wills Point Clays, together with numerous sections and lists of fossils. Resumé of History.

282. KENT, WILLIAM.

Art. Gold and Silver. Min. Resources of the U. S. 1889-1890. (Production of Gold and Silver in Texas, 1889-1890), p. 49. Washington, 1892.

From a table showing the "Production of gold and silver in the United States in 1889 and 1890," the following statistics are taken:

State.	GOLD.		SILVER.			
	Eleventh Census.	U. S. Mint.	Fine Ounces.		U. S. Coinage Value.	
	1889.	1890.	1889.	1890.	1889.	1890.
Texas	$6,828	....	323,438	300,000	$418,173	$387,878

283. KNOWLTON, F. H.

Report on a small Collection of Fossil Plants from Old Port Caddo Landing, on Little Cypress Bayou, Harrison County, Texas, made by T. Wayland Vaughan.

American Geol., Vol. XVI, pp. 308-309. Minneapolis, Nov., 1895.

See No. 405, "Section of the Eocene at Old Port Caddo Landing, Harrison County, Texas," etc., by T. Wayland Vaughan.

284. KUNZ, GEORGE FREDERICK.

Art. Precious Stones. Min. Resources of the U. S. 1888. (Gadolinite in Texas). pp. 582-583. Washington, 1890.

"This stone admits of a high polish, and is of a deep velvet-black color. During the last year large quantities of it were obtained near Bluffton, in Llano county, Texas, twenty-two miles from Burnet. The occurrence of this gadolinite was somewhat similar to that of allanite in Amherst county, Virginia. It has more than ordinary interest from the fact that it contains from 40 to 50 per cent. of yttria. About 1000 pounds were found in a single pocket, associated with xenotime, fergusonite, and euxenite. One crystal weighed 11 pounds, another 13 pounds, and a single group weighing 40 pounds was obtained. The productions of this locality exceeded in quality and size anything yet obtained."

285. ———————

Mineralogical Notes. (Topaz from Texas.)

Trans. New York Academy of Science, Vol. XIII, pp. 144-145. Feb. 19, 1894.

Topaz from near Palestine, Texas. Descriptions of five crystals. They are believed to have been transported from some northeastern point. See the title following.

286. ———————

Topaz from Texas.

Amer. Jour. of Science, III, Vol. XLVII, pp. 403-404. New Haven, May, 1894.

Description and measurements of several topaz crystals, "all more or less rolled, showing that they had been taken from the bed of some stream or brook. No other information was given about them than that they came from near Palestine, Texas,—evidently from the granite rocks." P. 403.

287. ———————

Art. Precious Stones. Min. Resources of the U. S., 1894. Nonmetallic Products.

16th Ann. Rept., U. S. Geological Survey. Part IV. (Amber in Texas), p. 603. Washington, 1895.

A brief announcement of the discovery of "amber in small nodules" near Pendennis, Lane county, Texas.

288. LERCH, DR. OTTO.

See Cummins, W. F., and Lerch, Otto.

A Geological Survey of the Concho Country, State of Texas.

Amer. Geologist, Vol. V, pp. 321-335. Minnneapolis, June, 1890.

289. LERCH, DR. OTTO.

Remarks on the Geology of the Concho Country, State of Texas. Amer. Geologist, Vol. VII, pp. 73-77; 2 cuts. Minneapolis, Feb., 1891.

A description of the beds between the Lower Cretacic, Trinity Sands of Hill, and the Permian as exposed in the vicinity of San Angelo, Texas, for which the name San Angelo Beds is proposed.

290. ————

Reports on the Iron Ore District of East Texas. Part II. Fuels and their Utilization. Chapter II. Lignites and their Utilization, with special references to the Texas Brown Coals. Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 38-63. Austin, 1891.

Contents: Introduction. Distillation of Lignites: Tar and its Derivatives, Parafine, Mineral Oil, Gas, Dyes. Lamp Black; Tanning Material; Sugar Refining; Fertilizers. Fuel: Coke, Briquettes, Drying the Lignites, Pressing the Briquettes; Lignites in Smelters; Raw Lignite in the Manufacture of Steel. Occurrence of Texas Lignites. Comparison of Lignites: Analyses. Method of Analysis. Literature: Parafines, Mineral Oils, and Tar; Lignites—Heating Effects of; Blacking; Tanning; Illuminating Gas; Utilization of Lignites in Smelters; Manufacture of Briquettes; Manufacture of Coke from Lignite.

"The State of Texas possesses immense deposits of this mineral treasure [lignites] covering a large part of her eastern territory, frequently associated with deposits of valuable iron ores. The age of the coal, as determined by different State Geological Surveys, is Tertiary, and, according to analyses made by different members of the present Survey, the coal is frequently of the finest quality, far superior to that so extensively used in European countries.

"These deposits have long been known by the people of Eastern Texas, but have been generally considered valueless, and consequently but little, indeed almost no mining of the material has been done in this region, with the exception of a few places where the coal has been used for household purposes. Dr. Buckley first gave a general outline of the formation in which the lignite occurred, and in the First Report of Progress of the present Survey it was more fully defined as 'Beginning on the Sabine River in Sabine county, the boundary line runs west and southwest near Crockett, Navasota, Ledbetter, Weimar, and on to Helena and the Rio Grande; thence back by Pearsall, Elgin, Marlin, Richland, Salem and Clarksville to Red river; including fifty-four counties in whole or in part.' The following year explorations were continued by the Survey, and a large amount of valuable material has been collected. The geologic features of the basin have been studied, the association of the lignites with the iron ores worked out, a number of analyses have been made to determine the economic value of the coal, and it is now beyond question that the lignitic basin of the east will be in the future an extensive iron and coal producing district of the State. This report is intended to call the

LERCH, DR. OTTO.

attention of the people to the wealth of this district, to show in a preliminary way how the brown coal has been utilized in European countries, especially in Germany, and to compare the material now used for various manufacturing purposes with the brown coal of the East Texas lignitic basin." P. 39.

291. LEVERETT, S.

See Taff, J. A., and Leverett, S.

Report on the Cretaceous Area north on the Colorado River.

Fourth Ann. Rept. of the Geol. Surv. of Texas, Pt. I, pp. 239-354. Austin, 1893.

292. LOUGHRIDGE, R. H.

Texas.

Macfarlane's American Geological Railway Guide. 2nd ed., pp. 409-413. N. Y., 1890.

List of Geological Formations found in Texas and Indian Territory. Lists of Railroads in Texas; Stations and Distances from terminal Points; and Geological Formations at each Station, together with Notes.

293. MACKENTOSH, J. B.

See Hidden, W. E., and Mackentosh, J. B.

A Description of several Yttria and Thoria Minerals, from Llano County, Texas.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 474-486. New Haven, Dec., 1889.

294. MAGNENAT, L. E.

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, p. lxi. Austin, 1892.

A brief account of the work done in the Chemical Laboratory of the State Geological Survey from 13th of December, 1890, to 1st of January, 1891. During that time 555 analyses were made by Messrs. Magnenat, J. H. Herndon and G. H. Wooten.

295. MARCOU, JULES.

American Geological Classification and Nomenclature. 75 pages.

Cambridge, May, 1888. [Printed for the author by the Salem Press.]

Contents: I. Introduction. II. Primitive or Azoic Series. III. Taconic System. Order of discoveries and original researches on the Taconic system. IV. Cambrian or Champlain System. V. Silurian system. VI. Devonian system. VII. Carboniferous system. VIII. Dyassic system. IX. Triassic system. X. Jurassic system. XI. Cretaceous

MARCOU, JULES.

system. XII. Lower Tertiary system. XIII. Upper Tertiary or Helvetian system. XIV. Quaternary and Recent, or Modern Series. Glacial Epoch. Living Glaciers. XV. Explanation of the tabular view of American classification and nomenclature. Synchronism and Homotaxis. The Geological map of Europe. XVI. Conclusion. Tabular view of American classification and nomenclature.

This is one of Professor Marcou's controversial papers. References to Texas geology are as follows:

The Triassic in Texas, p. 31; Triassic reptiles, p. 33; the Jurassic system of Tucumcari regarded by the brothers Shumard as belonging to the Upper Cretaceous system of Texas, pp. 38-39.

"Seldom has such an accumulation of errors, paleontological, stratigraphical and lithological been committed in American geology. For the mistakes did not stop there, and Messrs. J. Hall and the brothers Shumard [see "*A Partial Report on the Geology of Western Texas*, Austin, 1886], followed by Dr. R. H. Loughridge and others, classified as Lower Cretaceous or Dakota Group of Texas all the Triassic system besides the Jurassic; at the same time they contrived to synchronize the *Neocomian* of Fort Washita, the False Washita and Canadian rivers with the Marly Chalk or *Turonian*." P. 39.

The Cretaceous system: Neocomian in Texas and Indian Territory, p. 43; reference to the work of Mr. Hill, p. 43; reference to a tabular view of the Texas Cretaceous "showing three great divisions as in Europe [1861] (*Notes on the Cretaceous and Carboniferous Rocks of Texas*, by J. Marcou, in *Proceed. Boston Soc. Nat. Hist.*, Vol. VIII, p. 93, Boston)." P. 45; references to Dr. C. A. White (*Eleventh Ann. Rept. U. S. Geol. and Geogr. Survey for* 1877, p. 264, Washington, 1879), and to Messrs. White and Hill (*On the Cretaceous Formation of Texas and their relation to those of other portions of North America*, by C. A. White, in *Proceed. Acad. Nat. Sci.*, Philadelphia, February, 1887). Further reference to the papers and work of Mr. R. T. Hill (*The Topography and Geology of the Cross Timbers and surrounding region in Northern Texas*, in *Amer. Jour. Sci.*, Vol. XXXIII, p. 299, 1887; *The Texas Section of the American Cretaceous, Amer. Jour. Sci.*, Vol. XXXIV, Oct., 1887, p. 287). Pp. 46-47, Groups or Sub-Stages of Cretaceous (Texas, Hill, 1887), Tabular view, p. 73.

Professor Marcou claims priority in the recognition of the Neocomian in Texas, giving the date as 1853, p. 45. In writing of the Cretaceous, as elsewhere in this publication, he criticises with extraordinary severity those whose views differ from his own.

296. ——————

The Original Locality of Gryphæa Pitcheri, Morton.

Amer. Geologist, Vol. III, pp. 188-193. Minneapolis, March, 1889.

Synopsis: Extract from Bulletin 45 of the U. S. Geol. Survey, by Robert T. Hill, in which Dr. Samuel George Morton is credited with being "the first to make allusion to the Cretaceous strata of Texas." "He describes," continues Professor Hill, "from 'the Calcareous platform of

MARCOU, JULES.

Red river,' the fossil *Gryphaea Pitcheri,* now accepted as the most characteristic fossil of the typical Texas Cretaceous. This locality, we can only surmise, was the same as that now called the Staked Plains (Llano Estacado) region of Texas. The specimens were collected by army officers."

Morton's statement of the manner in which he received the fossil from Dr. Pitcher, "who obtained it from the plain of Kiameshia, in Arkansas." Letter from Dr. Z. Pitcher, dated Detroit, October 12, 1859. Extract: "The Kiamechia is a small stream which empties into the Red river a few miles above Fort Towson. My little fossil which has acquired so much consequence from the discussions into which it has been drawn by scientific names, was picked up on the plains drained by this little rivulet, through which our troops were marking out a road from Fort Smith to Fort Towson, in 1833.

"In 1853," the author (Marcou) "came upon that *Gryphaea pitcheri,* not far west from its original area, at Fort Washita, and farther west up the Washita river. * * * I saw it also, a few miles north on the banks of the Canadian river, at the great bend of that river." Dr. Newberry's mention of *G. pitcheri* in the Report of the Ives Expedition, 1861, and later in the Report of the Macomb Expedition, 1876. The author disputes Newberry's determination of the fossil and its associations. Quotation from Circular No. 1, School of Geology, University of Texas: "The reaffirmation of the age of the Tucumcari section along the northwest corner of Texas to be uppermost Jurassic as originally described by Marcou," (written by Professor Hill).

This is one of the controversial papers concerning the existence of Jurassic rocks in Texas and the part played by *G. pitcheri.*

297. ——————

Jura, Neocomian and Chalk of Arkansas.
American Geologist, Vol. IV, pp. 357-367. Minneapolis, Dec., 1889.

A review of the Annual Report of the Geological Survey of Arkansas, Vol. II, 1888, entitled "The Neozoic Geology of Southwestern Arkansas," by Robert T. Hill, in which there are several references to Texas on account of the typical occurrence of Cretaceous rocks in that State.

298. ——————

The American Neocomian and Gryphæa Pitcheri.
Correspondence.
Amer. Geologist, Vol. V, pp. 315-317. Minneapolis, May, 1890.

A criticism of Professor Hill's "Preliminary Annotated Check List of the Cretaceous Invertebrate Fossils of Texas." Bulletin No. 4 of the Geological Survey of Texas.

299. ——————

On the Classification of the Dyas, Trias and Jura in Northwest Texas.

MARCOU, JULES.

Amer. Geologist, Vol. X, pp. 369-377. Minneapolis, Dec., 1892.

This paper is of a controversial character consisting mainly of a criticism of the work of Mr. W. F. Cummins, as published in the Second and Third Annual Reports of the Geological Survey of Texas, with reference to the classification, nomenclature, lithology, and paleontology of the strata in Northwest Texas, in which the writer points out what he conceives to be errors. Both Professor Cope and Mr. Cummins are severely criticised for not giving the localities and "minute stratigraphic position of the Texas fossil vertebrates." The author disagrees with Mr. Cummins in his identification of Big Tucumcari Mountain (p. 372). The paper closes with a table giving Mr. Cummins' Classification of Strata in Northwest Texas and New Mexico, made in 1890-91, and Mr. Marcou's, made in 1853, in parallel columns.

300. ———————

Remarks on a part of the Review of the Third Texas Report. Correspondence.

Amer. Geologist, Vol. XI, pp. 212-214. Minneapolis, March, 1893.

Another paper of a controversial character concerning the age of the Tucumcari Beds in New Mexico, chiefly a criticism of the correlations of Professor Hill. Hill's Series of 1892 and the author's (Marcou's) of 1853, are published in parallel columns (p. 213). The author maintains the Jurassic age of the Tucumcari Beds.

301. ———————

Growth of Knowledge concerning the Texas Cretaceous.

Amer. Geologist, Vol. XIV, pp. 98-105. Minneapolis, Aug., 1894.

A criticism of Professor Hill's paper entitled "Geology of parts of Texas, Indian Territory and Arkansas adjacent to Red River" (Bull. Geol. Soc. Amer., Vol. V, pp. 297-338). The views of Professor Hill, the author contends, need many corrections, and he proceeds to review briefly the work of Roemer, G. G. Shumard, himself (Marcou) and Hill. The confusion arising from the incorrect determination of certain species of *Gryphaea* is pointed out. The paper closes with a "Table of Evolution of Knowledge of the Texas Cretaceous," as conceived by the author.

302. ———————

The Jura of Texas.

Proceedings of the Boston Soc. of Nat. Hist., Vol. XXVII, pp. 149-158. 1896.

A historical sketch of the Jura in Texas with references to Capt. John Pope's "Report of Exploration of Route for the Pacific Railroad near the Thirty-second Parallel," 1854; Marcou's "Geological Report," 1855; Mar-

MARCOU, JULES.

cou's "Geology of North America" (Zurich), 1858; R. T. Hill's "Texas Section of the American Cretaceous," American Journal of Science, III, Vol. XXXIV, pp. 305-306, 1887; also his "Topography and Geology of the Cross Timbers and Surrounding Regions in North Texas," Amer. Jour. of Sci., III, p. 299, 1887; his "Neozoic Geology of Southwest Arkansas," Ann. Rept. Geol. Surv. Ark. for 1888, Vol. II, p. 121; "Events in North American Cretaceous History illustrated in the Texas-Arkansas Division of the Southwestern Region of the United States," Amer. Jour. of Sci., III, Vol. XXXVII, p. 290, 1889; and his "Check List of Cretaceous Invertebrate Fossils, 1889; Marcou's Review of the Ann. Rept. of the Geol. Surv. of Ark. above mentioned, Amer. Geologist, Vol. IV, pp. 357-367, 1889; Annual Reports of the Geol. Surv. of Texas; Hill's Monograph on "The Invertebrate Paleontology of the Trinity Division," Proc. Biol. Soc. of Washington, Vol. VIII, pp. 9-40, 1893; Cragin's "Invertebrate Paleontology of the Texas Cretaceous," Fourth Ann. Rept. of the Geol. Surv. of Texas, 1893; Dumble and Cummins' "Kent Section and Gryphæa Tucumcarii, Marcou," American Geologist, Vol. XII, pp. 309-314, 1893. Discussion of the conclusion of Messrs. Dumble and Cummins, which is: "Since, therefore, in the Kent Section we have Prof. Marcou's *G. dillatata* var. *Tucumcarii* in the same bed with such typical Cretaceous forms as *G. Pitcheri, Ammonites leonensis, A. peruvianus, Terebratula Wacoensis*, etc., it must be considered a true Cretaceous form. Its discovery in this connection simply adds one more to the list of fossils occurring in the Washita division of the Cretaceous of Trans-Pecos Texas, whose close resemblance to well-known Jurassic types would, under any less conclusive evidence of its Cretaceous age, warrant its reference to the Jurassic." Marcou's conclusion: "The conclusions of Messrs. Dumble and Cummins are based on paleontological grounds only, without any regard to stratigraphy, and we may add, against a well-balanced and correct stratigraphical classification, for there is no reason whatever to suppose that the Jurassic deposits are missing above the Trias in the Tucumcari area."

Reference to Ammonites described by Jose G. Aguilera and Professor Hyatt. Marcou's final conclusion: "The conclusion reached in 1853, when I was at Pyramid Mount, Tucumcari, is confirmed by all I have seen since. The horizon of *Gryphaea Tucumcari* is Jurassic. Moreover, it is the uppermost subdivision of the American Jura. The strata below, and between it and the Trias, belong to the Jura also, and are synchronous with the Bosque division, and very likely with the Fredericksburg division of Texas."

The Lower Cretaceous of Texas and *Gryphaea Pitcheri.* Paleontological confusion. *G. sinuata* var. *Americana.* The Tucumcari area. The Lower Cretaceous or Neocomian Fauna. The Sedimentary Strata of Texas.

303. MELCHER, J. C.

Notes on the Economic Minerals of Fayette County.

Geological and Scientific Bulletin, Vol. I, No. 8. Houston, December, 1888.

"The thickest and best lignite beds visible in this county are on O'Quinn

MELCHER, J. C.

and Ironore creeks. These are visible eight feet thick, and bottom not in sight. They burn well in the open hearth or fire, but smell somewhat of sulphur. They are perfectly black, and show distinctly the woody structure. There are also several other strata of two or three feet in thickness in the vicinity, of which the lowest seam is always best. I have also found these thinner beds in digging wells.

"There is near Swiss Alps a bed of solid clear gypsum, about two feet thick, which is twenty-four to forty feet below the surface, and is found in digging and drilling wells.

"Near Muldoon, at a washout on a hill, there crops out a bed of crumbly gypsum, of various brilliant colors, in great quantity. I think this will be a fine fertilizer.

"I think Fayette county has the best silicious limestone quarries in the State. These are near Muldoon. The rock lies in strata of workable thickness, and its jointed structure makes it easy to quarry.

"Fine kaolin, or potter's clay, is found in the vicinity of Flatonia, and at other places in the county.

"There is in O'Quinn creek a stratum eighteen inches to two feet thick, and some two hundred yards long, of a pure white fine soft sandstone. It is a fine polishing stone or sand, and very light in weight."

304. MERRILL, GEORGE P.

See Whitfield, J. E., and Merrill, G. P.

The Fayette County, Texas, Meteorite.

Amer. Jour. of Science, III, Vol. XXXVI, pp. 113-119. New Haven, Aug., 1888.

305. ——————

The Collection of Building and Ornamental Stones in the U. S. National Museum: A Hand-Book and Catalogue.

Report of the Smithsonian Institution, 1885-'86, Pt. II, pp. 277-648, and Pl. I-IX. Washington, 1889.

Texas: Granites in, p. 425; limestones and dolomites in, p. 405; marbles in, p. 385; sandstones in, p. 460; slates in, p. 470; soapstone in, p. 359.

The following specimens are catalogued from Texas:

Limestone [Marble]. Light yellow; compact; fossiliferous, from near Austin.

———— Cretaceous; drab; compact; coarsely fossiliferous, Austin.

———— Lower Silurian; light drab, with purple veins; very fine and compact. Near Burnet.

———— Lower Silurian; very light drab; fine and compact. Near San Saba.

———— Blue-gray crystalline. Burnet.

Dolomite [Marble]. Dull red, with net-work of lighter lines. Burnet.

Dolomite. Silurian; buff; fine and compact. Near San Saba.

———— Silurian; fine; light-colored. Near San Saba.

———— Silurian; light buff; fine and compact. Near San Saba.

MERRILL, GEORGE P.

Dolomite. Lower Silurian; nearly white; coarsely crystalline. Near San Saba.

——— Silurian; pink; fine and compact. Near San Saba.

Ferruginous Dolomite. Silurian; fine and compact; pinkish, near San Saba.

Limestone. Light-colored; fine; porous. Near Austin (two specimens).

——— Cretaceous; light-colored; fine; porous. Near Austin.

——— Light-colored; fine; porous. Round Rock.

——— Drab; compact. Near Burnet.

Magnesian Limestone. Cretaceous; light-colored; fine; porous. Near Austin.

——— ——— Cretaceous; light-colored; fossiliferous. Near Austin.

Biotite Granite. Fine; pink. Eight miles from Burnet.

——— ——— Coarse; red. Eight miles from Burnet.

Diorite. Medium; light greenish gray. Near El Paso.

Sandstone. Lower Silurian; coarse; brown. Near Burnet.

——— Lower Silurian; coarse; dull red. Near Burnet.

——— Carboniferous; fine; very light gray. Near Mormon Mills, Burnet county.

306. MERRILL, J. A.

Fossil Sponges of the Flint Nodules in the Lower Cretaceous of Texas.

Bull. of the Museum of Comp. Zoology, Vol. XXVIII, No. 1, (Geol. Series, Vol. III,), p. 26, pl. 1. Cambridge, 1895.

Contents: (Introduction.) A Statement of the Questions involved. Organisms found in the Flint. Condition of Preservation of the Sponge Spicules. Comparison with English Chert. Classification of the Spicules. Monactinellidae, Zittel. Tetractinellidae, Marshall. Lithistidae, Oscar Schmidt. Hexactinellidae, Oscar Schmidt. Formation of the Nodules. Summary.

"So far as I have been able to ascertain, the minute structure of the Cretaceous flints of America has never been studied except in a general way, and nothing whatever has been published on the microscopic organisms composing them. The field is therefore a large as well as a fascinating one, and this effort is intended only as a beginning of what is hoped will prove a fruitful line of inquiry. The flint nodules from which the specimens were taken for study were collected in a quarry near Austin, Texas, and brought to Cambridge by Mr. Edward E. Cauthorne. They vary greatly in shape and size; and, owing, perhaps, to small areas of calcite scattered through the mass, they vary somewhat in hardness. The hardness is often greater than that of glass, and the flint will generally scratch glass. In shape they are spherical, cylindrical, or flat; and in size they vary from two inches to a foot or more in diameter. The color is dense black, with white or gray spots mixed irregularly through it, varying in size from microscopic to that of a pin-head." P. 1.

307. NEWBERRY, SPENCER B.

Art. Portland Cement. Min. Resources of the U. S., 1895. Nonmetallic Products except Coal.

Seventeenth Annual Report of the U. S. Geological Survey, Part III (continued).

(Portland Cement in Texas), p. 884. Washington, 1896.

From a table showing the "Product of Portland Cement in the United States, 1894 and 1895.

State.	1894.		
	Number of works.	Product, Barrels.	Value not including barrels.
Texas.	1	8,000	$24,000
	1895.		
"	1	10,000	$30,000

308. OSANN, A.

Report on the Rocks of Trans-Pecos Texas.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 123-138. Austin, 1893.

Contents: [Introduction.] Igneous Rocks. Rocks from Quitman Mountains. Rocks from Sierra Blanca. Rocks of the Wiley Mountains. Rocks from the Diablo Mountains. Rocks from the Davis Mountains. Rocks from the Viejo Mountains. Rocks from the Eagle Mountains. Rocks of the Van Horn Mountains. Rocks from the Chisos Mountains. Rocks from the Carrizo Mountains.

[A list of Rocks determined by Dr. Osann will be found in the Report on Trans-Pecos Texas, by W. H. Streeruwitz, Fourth Ann. Rept. of the Geol. Survey of Texas, 1892, Pt. I, pp. 146-148. 1893.]

"The collections of the Geological Survey contain a series of rocks collected in Trans-Pecos Texas by Prof. von Streeruwitz on his travels for exploration of the ore deposits during the last three years. It has not been possible during my short stay in the Geological Survey to work up a detailed investigation of that material, but only to give a brief preliminary report, partly because the thin sections for microscopical examination of all specimens could not be gotten ready, partly because no chemical tests or analyses have been made of the rocks or their constituents. Besides, there are wanting special notes in regard to the occurrence of these rocks in the field. Everybody familiar with the progress of Petrography during the last years knows that besides the microscopical investigation on the one hand, the chemical in the laboratory, and the geological

OSANN, A.

in the field, on the other, are absolutely necessary for the right understanding of rocks. If, notwithstanding, some unconnected and incomplete notes on the subject are given, it is done in accordance with the order of the director of the Geological Survey, with a view to giving an idea of the great variety, especially of igneous rocks, in Western Texas, and for the reason that no petrographical description of them has yet been given.

"The geological material collected in Western Texas can be divided into four groups: 1, Igneous Rocks; 2, Crystalline Schists; 3, Sedimentary Rocks; 4, Ore Specimens.

"Only the first group will be described in this report. Of crystalline schists there are only a few specimens from 'Mica Tanks' in the Van Horn Mountains. They consist of gneisses (muscovite gneiss and muscovite and biotite-bearing gneiss), mica schists and amphibole gneisses in transition to amphibolites. These rocks are not yet studied under the microscope." P. 123.

309. ——————

Melilite-Nepheline-Basalt and Nepheline-Basanite, from Southern Texas.

Jour. of Geology, Vol. I, No. 4, pp. 341-346. Chicago, 1893.

"These basaltic rocks were collected by Professor Dumble and Mr. Taff in Uvalde county, Southern Texas. On the Geological Map of the United States, compiled by C. H. Hitchcock, 1886, there are two of the localities marked near the boundary of the Cretaceous and earlier Tertiary formation between 99° and 100° longitude, and on the 29th degree of latitude. According to the statement of Professor Dumble, one part of the rocks appears in dikes in the upper portion of the lower Cretaceous formation, while the other forms hills and buttes. Upon microscopical examination it is evident that the specimens collected belong to two different groups of rocks. The microscope shows that those occurring in dikes consist of typical melilite-bearing nepheline-basalt, while those making up hills and buttes are nepheline-basanites tending toward phonolites in composition." P. 341.

A description of these rocks, which were subjected to a microscopic examination, follows.

"A microscopical examination of the basaltic rock from Pilot Knob, near Austin, Travis county, was made for the purpose of comparison with the rocks from Southern Texas just described. The rock was found to be a nepheline-basalt porphyritic with numerous phenocrysts of olivine. The fine grained ground mass consists essentially of augite-crystals cemented together by non-individualized nepheline in very small amount." P. 346.

Noticed in Am. Naturalist, Vol. 28, pp. 799-800, Sept., 1894.

310. OWEN, J.

Notes on the Geology of the Rio Grande Valley.

Geological and Scientific Bull., Vol. 1, No. 2. Houston, June, 1888.

"It does not appear to be generally known that along the valley of the

OWEN, J.

Rio Grande there exists in the Cretaceous rocks extensive beds of coal. The Geological horizon of these beds is equivalent to the Fox Hills group of this system, and in the lower Rio Grande valley perhaps the equivalent of the Laramie group. These coal beds extend from Laredo to near El Paso, and into New Mexico. They are somewhat disconnected, owing, perhaps, to seismic disturbances and subsequent erosion. They were evidently continuously deposited, and rest comfortably upon the Lower Cretaceous rocks. These coal beds are to be found in Webb, Dimmit, Zavala and Maverick counties, and west and southwest of Maverick county, in Mexico, extending westward into Pecos and Presidio counties. The croppings of these beds can be seen in numerous localities, and in Maverick county coal is being mined at the rate of one hundred tons per day. This is a good commercial coal, and should not be confounded with the Tertiary lignite beds of the Gulf Coast region. The stratum now being worked in Maverick county, near Eagle Pass, is five feet thick. It is a semi-coking coal, is easily ignited, and burns freely; the residue is a gray ash; it does not make clinkers; is very well adapted for use in engines, and is used upon the engines of the Southern Pacific railroad. Maverick county contains 120 square miles of land in this coal field. * * * ”

* * * * * * *

Attention is called to a “drift deposit” which “covers a large portion of southwest Texas, in many places to a depth of twenty feet. It is composed of rounded fragments from various geological periods. Boulders of igneous rocks, some of them eighteen inches in diameter, are promiscuously scattered over the tops of the highest hills. Upon the Mexican side of the river, where the high limestone mountains presented a barrier to the drift agencies, no igneous boulders are seen. The drift here is wholly composed of fragments from these mountains. The igneous boulders from this deposit can nowhere be found in place nearer than two hundred and fifty miles to the northwest.”

The origin of this drift is ascribed to glacial action.

311. ——————

[Report of.]

Reports of Geologists for Southern Texas.

Texas Geol. and Min. Surv. First Rept. of Progress, 1888, pp. 69-74. Austin, 1889.

Scope of the Report. “On the 8th of November (1888), I commenced active operations in the field, beginning my work at the mouths of Pecos and of Devil's rivers, and following the line of the Galveston, Harrisburg and San Antonio Railroad as far as Uvalde; then I returned to Eagle Pass and resumed work by going down the right bank of the Nueces river as far as Encinal county; thence across the country to Laredo; thence up the Rio Grande to San Lorenzo creek to a point northeast from Eagle Pass, and from there to this place (Eagle Pass).”

Coal southwest of Uvalde. Coal at Eagle Pass. The Hartz Mine. Average thickness of coal seam over five feet. Agricultural resources not developed. Aridity. Source of water supply. The outcrop of a *sand bed* 200

OWEN, J.

feet thick. Val Verde County. Geology. Kinney County: Geology; Soil; Building stone. Uvalde County: Geology; Coal; Asphaltum; Dikes and Metamorphic Effects; Igneous Rocks ten miles west of Uvalde; Syncline at Uvalde; Water. Zavala County; Two-thirds within the bounds of the coal field; Artesian Water. Webb County: Western half within the Nueces Coal Field; Coal seam 18-33 inches thick with a 2-inch parting; Character of the Coal; Worked at San Tomas. Dimmit County: Carrizo Sandstone; Water; Western Boundary of the Nueces Coal Field; Diversity of Soils. Maverick County: Middle and Upper Cretaceous; Soils; Coal five miles northwest of Eagle Pass. Length of Exposure. Brick Material at Eagle Pass.

312. PARKER, EDWARD WHEELER.

Art. Coal. Min. Resources of the U. S., 1889-1890.
(Coal in Texas), p. 271. Washington, 1892.

Coal product for 1889, 128,216 short tons; value, $340,617. Coal product for 1890, 184,440 short tons; value, $465,900. Nine counties produced coal, but only four commercially, viz.: Erath, Maverick, Medina and Webb. Gradual increase in production. Table showing Coal Product in Texas for 1889 and 1890.

313. ——————

Art. Coal. Min. Resources of the U. S., 1891.
(Coal in Texas), p. 325. Washington, 1893.

Coal product for 1891, 172,100 short tons; value, $412,360. Loss in output for the year estimated at 12,340 short tons. Table of Coal Product in Texas for 1889, 1890, and 1891.

314. ——————

Art. Gypsum. Min. Resources of the U. S., 1891.
(Gypsum in Texas), p. 582. Washington, 1893.

The Lone Star Plaster Company of Quanah, Texas. Capital, $100,000. Operations begun April, 1892. Mill capacity 75 tons per day. Promoters of the enterprise are interested in the "Acme Cement Plaster Company." The product is known as "Climax" plaster.

315. ——————

Coal. Min. Resources of the U. S., 1894.
Nonmetallic Products.
16th Ann. Rept., U. S. Geol. Survey, Part IV.
(Coal in Texas), pp. 193-194. Washington, 1895.

The total product in 1894 was 420,848 short tons; spot value, $976,458. Reference to the reports of E. T. Dumble and Prof. R. T. Hill. See titles Nos. 86, 88.

"Reliable statistics of coal production in Texas have only been obtained since 1889, when the Eleventh United States Census, after a careful canvass

PARKER, EDWARD WHEELER.

of the State, reported an output of 128,216 short tons, valued at $340,620. The output from 1883 to 1888, inclusive, has been estimated at from 75,000 to 135,000 short tons annually, and while these figures were estimates merely, the fact that the product in those years was from the same mines as the output in 1889, and that the estimated product was quite close to that reported by the Census Office, indicates that the estimates were not very far from the actual output.

"With the exception of a slight decrease in 1891 from the output in 1890, the product of coal in Texas has shown a steady increase since 1889. While the output in 1891 was less than that of 1890, it exceeded that of 1889 by more than 40,000 tons. The product in 1892 was 73,590 short tons, or nearly 43 per cent. larger than that of 1891. In 1893 the product increased 56,516 short tons, or 23 per cent. over 1892, and in 1894 the increase was 118,642 short tons, or more than 39 per cent. The product in 1894 was more than three times that of 1889, while the value was within $25,000 of reaching $1,000,000. With the bringing in of the Presidio county, or San Carlos, fields in 1895, and the development of industrial enterprises in the State, the production of coal is likely to continue to increase."

Table showing "Coal Product of Texas since 1889" (that is, from 1889-1894, inclusive.)

316. ————————

Art. Asphaltum. Min. Resources of the U. S., 1894.
Nonmetallic Products.
16th Ann. Rept., U. S. Geological Survey, Part IV.
(Asphaltum in Texas), p. 433. Washington, 1895.

"The commercial product in Texas in 1894 was from the lithocarbon properties in Uvalde county * * *."

317. ————————

Art. Salt. Min. Resources of the U. S., 1894.
Nonmetallic Products.
16th Ann. Rept., U. S. Geological Survey, Part IV.
(Salt Product of Texas), p. 655. Washington, 1895.

"Texas produced 142,857 barrels [of salt] in 1894, valued at $101,000, compared with 126,000 barrels, worth $110,267, in 1893."

318. ————————

Art. Coal. Mineral Resources of the U. S., 1895.
Metallic Products and Coal.
17th Ann. Rept., U. S. Geological Survey, Part III.
(Coal in Texas), pp. 521-522. Washington, 1896.

"The total product in 1895, 484,959 short tons; total value, $913,138.

"The principal features of the coal mining industry in Texas during 1895 were an increase in output of about 15 per cent. over that of 1894, a decrease in value of 7 per cent. compared with the previous year, and

PARKER, EDWARD WHEELER.

the marked developments of the lignite beds in the vicinity of Rockdale, Milam county. Milam county is credited with an output very little short of 100,000 tons, and this had much to do with the falling off in the total value. * * *

* * * * * * *

"Considerable attention was given in 1895 to the extensive lignite beds in the vicinity of Calvert, Robertson county, and work of a development nature was carried on by the Calvert Coal and Clay Company, with promises of this also becoming an important producing region. * * * The physical properties of the lignites will not permit transportation to a great distance, nor will they stand much increased cost in the way of freight. Lignite coal is also mined in Medina county, the product from which, added to that of Robertson and Milam counties, made the total output of lignite in 1895 124,343 short tons.

"The bituminous mines of Erath, Parker, Maverick and Webb counties contributed their usual quota to the product of 1895. Mines have also been opened in Coleman, Montague, and Palo Pinto counties, and from the last mentioned an output of 12,500 tons was obtained in the four months the mines were operated."

Tables are given showing the "Coal product of Texas since 1889," and the "Coal product of Texas in 1895, by counties."

319. ———————

Art. Asphaltum. Min. Resources of the U. S., 1895.
Nonmetallic Products except Coal.
17th Ann. Rept., U. S. Geological Survey, Part III (continued).
(Asphaltum in Texas), p. 754. Washington, 1896.

"Asphaltum in one form or another occurs in several localities in Texas. Those which have been developed are in Uvalde county, about six miles south of Cline Station, on the Southern Pacific Railroad. The asphaltum occurs here, impregnating a bed of fossiliferous limestone. The deposit is large and easily mined, as very little overburden has to be removed before the material can be stripped off the surface. Extensive works have been erected for treating the asphalt, which is prepared and sold in two conditions, as mastic and gum. * * * The city of Houston, Texas, has paved a number of streets with asphalt sheets made from the Cline mastic.

"The more valuable condition in which the material is sold is that of refined or gum asphaltum. The owners have given this the name of 'litho-carbon.' * * * Four hundred and fifty tons of litho-carbon were shipped in 1895. * * *

"There are also extensive beds of bituminous sandstone in the same county, near the town of Uvalde, but they have not been thoroughly prospected, and the interested parties are at present unwilling to make public their plans. Deposits have also been prospected somewhat in Montague county, but no output of commercial importance had been obtained at the close of 1895."

320. PARKER, EDWARD WHEELER.

Art. Sulphur and Pyrites. Min. Resources of the U. S., 1895. Nonmetallic Products except Coal.

17th Ann. Rept., U. S. Geological Survey, Part III (continued).

The Texas Sulphur Deposits, pp. 966-967. Washington, 1896.

An abstract of and quotation from the contribution of Dr. Eugene A. Smith on "Native Sulphur in [El Paso county] Texas," published in *Science*, May 1, 1896. See Title No. 357.

321. ——————

Art. Gypsum. Min. Resources of the U. S., 1895. Nonmetallic Products, except Coal.

17th Ann. Rept., U. S. Geological Survey, Part III (continued).

(Product of Gypsum in Texas), pp. 979, 980, 981. Washington, 1896.

From a table showing "Product of gypsum in the United States in 1895, by States:

STATE.	Total product.	Calcined into Plaster of Paris.		
		Before calcining.	After calcining.	Value of calcined plaster.
	Short tons.	Short tons.	Short tons.	
Texas.	10,750	10,750	7,166	$36,511

From a table showing "Product of gypsum in the United States in 1894, by States:

STATE.	Total product.	Calcined into Plaster of Paris.		
		Before calcining.	After calcining.	Value of calcined plaster.
	Short tons.	Short tons.	Short tons.	
Texas.	6,925	6,925	4,750	$27,300

322. ——————

Art. Salt. Min. Resources of the U. S., 1895. Nonmetallic Products, except Coal.

17th Ann. Rept., U. S. Geological Survey, Part III (continued).

PARKER, EDWARD WHEELER.

(Salt Production in Texas), pp. 985, 986, 987, 990, 991. Washington, 1896.

From tables on the pages above indicated, the following statistics have been compiled:

In 1892, Texas produced 121,250 barrels of salt, valued at $ 99,500.
In 1893, Texas produced 126,000 barrels of salt, valued at 110,267.
In 1894, Texas produced 142,857 barrels of salt, valued at 101,000.
In 1895, Texas produced 125,000 barrels of salt, valued at 55,000.

In 1894, Texas produced 4,379 barrels of table, and 138,478 barrels of common fine salt; in 1895, 125,000 barrels of common fine salt.

323. PEALE, A. C.

Art. Mineral Waters. Min. Resources of the U. S., 1887. (Mineral Springs in Texas), p. 686. Washington, 1888.

List of seven springs from which reports had been received, viz.;

Crabtree's Sour Wells, Sulphur Springs, Hopkins county; Dalby Springs, Dalby Springs, Bowie county; Hynson's Iron Mountain Spring, Marshall, Harrison county; Mineral Wells, Mineral Wells, Palo Pinto county; Sour Lake, Sour Lake, Hardin county; Texas Sour Springs, Luling, Caldwell county; Wootan Wells, Wootan Wells, Robertson county.

324. ————

Art. Mineral Waters. Min. Resources of the U. S., 1888. (Mineral Springs in Texas), pp. 628-629. Washington, 1890.

List of five springs from which reports had been received:

Crabtree's Sour Wells, Sour Springs, Hopkins county; Hynson's Iron Mountain Spring, Marshall; Palo Pinto Mineral Wells, Mineral Wells; Texas Sour Springs, Luling; Wootan Wells, Robertson county.

325. ————

Art. Mineral Waters. Min. Resources of the U. S., 1889-1890. (Mineral Springs in Texas), pp. 532-533. Washington, 1892.

Name and location of fourteen springs reporting in 1889, and of thirteen reporting in 1890:

Capp's Well, Longview, Gregg county; Dalby Springs, Texarkana, Bowie county; Elkhart Mineral Well, near Elkhart, Anderson county; Hynson's Iron Mountain Springs, Marshall, Harrison county; Mineral Wells Springs, Mineral Wells, Palo Pinto county; Montvale Springs, Marshall, Harrison county; Overall Mineral Well, Franklin, Robertson county; Page's Well, Georgetown, Williamson county; Richards' Wells, Rockdale, Milam county; Rosborough Springs, Marshall, Harrison county; Slack's Well, Fayette county; Texas Sour Springs, Luling, Caldwell county; Tioga Mineral Well, Tioga, Grayson county; Wootan Wells, Robertson county.

In 1890 thirteen springs reported sales: Capp's Well, Longview; Dalby Springs, Bowie county; Elkhart Mineral Well; Hynson's Iron Mountain

PEALE, A. C.

Spring; Mineral Well Springs; Montvale Springs, Marshall; Overall Mineral Well, Franklin; Richards' Wells, Rockdale; Rosborough Springs, Marshall; Slack's Well, Fayette county; Texas Sour Springs, Luling; Tioga Mineral Well, Tioga; Wootan Wells.

326. ——————

Art. Mineral Waters. Min. Resources of the U. S., 1891. (Mineral Springs in Texas), p. 608. Washington, 1893.

Name and location of ten springs, all of which have been included in preceding list.

327. ——————

Art. Mineral Waters. Min. Resources of the U. S., 1892. (Mineral Springs in Texas), p. 831. Washington, 1893.

Springs reporting for 1892: Capp's Well, Longview; Dalby Springs, Dalby Springs; Elkhart Mineral Wells, Elkhart; Hynson's Iron Mountain Spring, Marshall; Montvale Springs, Marshall; Mineral Wells, Mineral Wells; Overall Mineral Well, Franklin; Page's Well, Georgetown; Slack's Well, Walder Depot; Texas Sour Springs, Luling; Tioga Mineral Wells, Grayson county; Wootan Wells, Wootan Wells.

328. ——————

Art. Mineral Waters. Min. Resources of the U. S., 1893. (Mineral Springs in Texas), pp. 781-782. Washington, 1894.

"One new spring appears on the list credited to the State. Thirteen report sales in 1893. They are: Capp's Well, Longview, Gregg county; Dalby Springs, Dalby Springs, Bowie county; Elkhart Mineral Wells, Elkhart, Anderson county; Georgetown Mineral Water, Georgetown, Williamson county; Hynson's Iron Mountain Spring, Marshall, Harrison county; Mineral Wells, Mineral Wells, Palo Pinto county; Montvale Springs, Marshall, Harrison county; Overall Mineral Wells, Franklin, Robertson county; Rockdale Mineral Wells, Rockdale, Milam county; Slack's Wells, Waelder, Gonzales county (the spring is in Fayette county); Texas Sour Springs, Luling, Caldwell county; Tioga Mineral Wells, Grayson county; Wootan Wells, Wootan Wells, Robertson county."

329. ——————

Art. Mineral Waters. Min. Resources of the U. S., 1894. Nonmetallic Products.
16th Ann. Rept., U. S. Geological Survey, Part IV. (List of Commercial Springs in Texas), p. 718. Washton, 1895.

"There is no change from 1893 in the list of springs from Texas. Of the thirteen credited to the State twelve report."

330. PEALE, A. C.

Art. Mineral Waters. Min. Resources of the U. S., 1895. Nonmetallic Products, except Coal.

17th Ann. Rept., U. S. Geological Survey, Part III (continued).

(Mineral Springs in Texas), p. 1038. Washington, 1896.

"The list for Texas shows no change in 1895, remaining at thirteen."

331. PENROSE, R. A. F., JR.

Notes on certain Building Stones of East Texas.

Geol. and Scientific Bulletin, Vol. I, No. 11. Houston, March, 1899.

Science, Vol. XIII, p. 295. April 19, 1899.

Sandstones are the most important. Limestones are less widely distributed. The Penitentiary at Rusk "is built of a yellow sandstone composed of grains of siliceous sand and altered greensand. It is of a yellow color, easily cut, and occurs near the penitentiary in a bed about twelve feet thick." Claiborne age. Used for building chimneys, foundations, etc. "It is also found of a green color and compact clayey consistency." A white durable sandstone is found near Alto, Cherokee county. It is a capping of the Claiborne marls. A variety five miles west of Jacksonville is said to make good millstones. Brown sandstones are found in many places in East Texas. They are indurated Quaternary and Eocene sands. A good limestone occurs at Scott's quarry in Smith county.

332. ——————

Report of the Geologist for Eastern Texas.

Texas Geol. and Min. Surv. First Rept. of Prog., 1888, pp. 54-60. Austin, 1899.

Contents: The Iron Ores of Eastern Texas. 1. Lake or Bog Ores. 2. Impregnations. 3. Conglomerate Ore. 4. Clay Ironstone. Marion and Cass Counties. Smith and Cherokee Counties. Lignites of Eastern Texas.

"The determination of the exact geological position of the iron-bearing beds of Eastern Texas, and especially of those north of the Sabine river, is a matter of some difficulty, as many of the associated strata are not fossiliferous. Enough data have not yet been collected to make any definite statements as to their exact geological horizon except in a few isolated cases. It is probable, however, that they occur in several different horizons between the lignitic clays of the Eocene and the Quaternary deposits which cap this horizon in the iron-bearing regions that have been visited." P. 54.

333. —————— and HILL, ROBERT T.

See Hill, Robert T., and Penrose, R. A. F., Jr.

Relation of the Uppermost Cretaceous Beds of the Eastern and Southern United States, and the Tertiary-Cretaceous Parting of Arkansas and Texas.

PENROSE, R. A. F., JR.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 468-473. Dec., 1889.

334. ——————

A Preliminary Report on the Geology of the Gulf Tertiary of Texas from Red River to the Rio Grande.

First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 3-101. Austin, 1890.

Contents: Introduction. Descriptive Geology—Geography and Topography. Stratigraphy. Basal or Wills Point clays. The Timber belt or Sabine River beds. The Fayette beds. Post Tertiary deposits. Economic Geology—Iron Ores of East Texas. Benches. Building stones. Clays. Glass sands. Lime. Marls. Lignites; San Tomas coal mine; Uses of lignite; Analyses of lignite. Mineral springs. Oils. Salt.

"The name East Texas is generally applied to that part of the State lying east of the Brazos river. This area is bounded on the north by Indian Territory and Arkansas, on the east by Louisiana, on the south by the Gulf of Mexico, and on the west by the great prairie region of Central Texas. A large part of this area is a heavily timbered region, and marks the southwestern terminus of the great Atlantic timber belt, extending from the Arctic regions continuously along the coast of the Atlantic ocean and Gulf of Mexico, until it finally disappears in the mesquite and cactus prairies between the Colorado river and the Rio Grande.

"The country consists largely of the in-shore part of the bottom of the old Tertiary Sea, which once covered the whole Gulf coast. This area has been elevated into a table-land one hundred to seven hundred feet above the present sea level, sloping gradually to the southeast, and emptying its waters in the same direction into the Gulf of Mexico. Since its elevation it has undergone great erosion, and is still being denuded at a tremendous rate. The strata are all composed of sands and clays, and succumb very readily to the eroding action of the atmospheric agencies. The result is, that all that is left of the once level surface of this table land are a few flat-topped hills and ridges, such as are seen in the northeastern counties. East Texas, as thus defined, comprises a coast prairie region on the south, a great timber region in the center, and an interior prairie country in the north and northwest. The coast prairies reach inland along the Sabine about fifty miles, but as we go west they spread farther and farther towards the interior until, when we come to the Brazos, they reach up the river for over a hundred miles. Near the Gulf shore they are flat and low, rising twenty to thirty feet above tide water, thickly covered with grass and cut by steep-sided channels of many rivers and creeks. The monotony of the scenery is broken only by the narrow strips of timber which follow the meandering courses of the streams down towards the Gulf of Mexico. As we go inland the country slowly rises, and though the prairies in their easterly part maintain their flat character, to the west they become more undulating and broken, and groves of mesquite, hackberry, cottonwood, and other trees are seen in many places. Finally, we come to the beauti-

PENROSE, R. A. F., JR.

ful rolling country of Washington and Grimes counties, the southern border of the timber region. Continuing west across the Brazos, the prairies rapidly encroach more and more on the timber of the interior, until they cut it out altogether, and finally blend, beyond the Colorado, with the great prairies of Southwest Texas.

* * * * * * *

"The highest points in the timber region, like Mount Selman and Gent Mountain, in Cherokee county, Hynson's Mountain, in Harrison county, and many others, have their summits capped by a horizontal, or almost horizontal, bed of iron ore or sandstone, and to this covering they owe their existence, it having protected them from the erosion which has worn down the surrounding country. It has also given rise to a striking topography very much like that of the western lava plains on a small scale. The hills, locally called 'mountains,' sometimes occur as small, flat-topped hills—the 'butte' and 'mesa' of the west—and at others spread out in broad plateaus, sometimes covering an area of twenty or thirty square miles, deeply cut by the steep sided canyons, and often showing an almost perpendicular slope. Such regions afford a beautiful upland country, with a soil far different from the surrounding lowlands, and a climate excellently adapted to the cultivation of fruit. In fact, such lands are now among the greatest fruit districts of Texas, and bid fair to become a worthy competitor of the California fruit country." Pp. 7-8.

"For the sake of convenience in description, the Tertiary strata underlying East Texas have been divided as follows:

SECTION OF THE GULF TERTIARY OF TEXAS.

Later Tertiary? (*Grand Gulf*, Hilgard):	Fayette Beds.	Sands, Clays and Lignites.	300 to 400 feet.
	Timber Belt or Sabine River Beds.	Sands, Clays, Lignites and Glauconites, or Greensand Marls.	800 to 1000 feet.
Eocene:	Basal or Wills Point, Clays.		250 to 300 feet.

The iron ores of East Texas are classed as: 1, Brown Laminated Ores; 2, Nodular or Geode Ores; 3, Conglomerate Ores. Special attention is directed to the origin of these ores. See pp. 72, 76 and 79. On pp. 83-84, forty-one analyses of iron ores from East Texas, by Messrs. J. H. Herndon and L. E. Magnenat, are given.

335. ———————

The Manganese Deposits of Texas.

Chapter XVI of the Annual Report of the Geological Survey of Arkansas for 1890, Vol. I, pp. 432-447. Little Rock, 1891.

Contents: Location of the Deposits. The Geologic Relations of the Manganese Deposits. The Manganese Ores—mineralogical forms of the ores; Oxides of Manganese; Silicates of Manganese—Analysis of spessartite from Llano county, Texas; Analyses of andradite from Mason county, Texas; Analysis of polyadelphite from Franklin, New

PENROSE, R. A. F., JR.

Jersey; Analysis of tephroite from Mason county, Texas. Relation of the oxides and silicates of manganese. Float ore. Commercial value of the ores—Analyses of manganese ores from Central Texas; Analyses of manganese ores from the Spiller mine, Texas. Mode of Occurrence of the Manganese ores. Description of Localities—The Spiller Mine; the Kothmann tract; Analysis of manganese ore from the Kothmann tract, Texas; Horse Mountain; Analysis of manganese ore from Horse Mountain, Texas.

"The manganese ores of Texas occur in the central part of the State, mostly in Mason, Llano, and San Saba counties. The different deposits are from forty to sixty miles from railway transportation, and no ore has yet been shipped from any of them. Several places, however, have been prospected, especially the Spiller mine and the Kothmann tract in Mason county, and, to a lesser degree, Horse Mountain, in Llano county.

"The ores are associated with quartzites and gneisses, though micaceous and garnetiferous schists are frequently found in the neighborhood. The rocks are much disturbed and dip at various angles, sometimes standing vertically. They are supposed to be of pre-Cambrian age.

"The Paleozoic and Cretaceous rocks border this region on all sides, and areas of them frequently protrude far into, or cap hills of the crystalline rocks.

"*Mineralogical forms of the ores.*—The manganese minerals of the Central Texas region occur in the forms of oxides and silicates. The latter, so far as yet determined, generally represent manganiferous varieties of garnet, though the protoxide silicate of manganese known as tephroite has also been found.

"*The oxides of manganese.*—The oxides of manganese occur in either a massive form or as a granular crystalline aggregate, the two being more or less intimately associated. The massive variety has a black color, a smooth conchoidal fracture, and a hardness of 6 to 7. The crystalline variety is black, and often very soft, in which condition it represents pyrolusite. The oxides are generally associated with more or less silica, which sometimes amounts to from 15 to 25 per cent, and makes the true mineralogical nature of the ores doubtful. Dr. T. B. Comstock notes the existence of psilomelane, pyrolusite, and wad in the Central Texas region." Pp. 432-433.

336. ——————

The Iron Deposits of Arkansas.

Ann. Rept. of the Geol. Surv. of Arkansas for 1892, Vol. I. Little Rock, 1892.

Texas, Analyses of Iron Ores, p. 15; Classification of Iron Ores in Tertiary Strata, p. 106; Geologic Relations of the Iron Ores in Tertiary Strata, pp. 105-106; Origin of Tertiary Ores, pp. 134-138.

"The laminated ores are especially well developed in Cherokee county in Eastern Texas. They appear to have been derived largely from iron pyrites, assisted possibly in some cases by carbonate of iron, and glauconite. As already stated, the ore directly overlies a large glauconite bed, and in this, and immediately above it, iron pyrites is of common occurrence. In some

PENROSE, R. A. F., JR.

few places, where natural conditions have protected the bed from atmospheric influences, it is found that the pyrite is especially abundant at the top of the glauconite bed and immediately below the overlying clayey sand. Here it occupies the same position as the laminated ore elsewhere, and is frequently associated with sands and clays which often contain lignite." P. 135.

337. ———————

The Tertiary Iron Ores of Arkansas and Texas.

Bulletin Geol. Soc. Amer., Vol. III, pp. 44-50. 1892.

Contents: Distribution of the Ores. Nature of the Ores: Nodular Ores; Laminated Ores. Origin of the Ores. Conclusions.

The general conclusions reached by the author are:

"1. That the iron ores of Texas and Arkansas occur mostly in two positions in the Eocene series of the Tertiary.

"2. That the ores were originally deposited in the form of oxide, carbonate and sulphide contemporaneously with the associated strata, and that they were subsequently segregated mostly as carbonate and sulphide.

"3. That the ores as now found are the products of the oxidation of the carbonate and sulphide, the nodular ores being derived from the carbonate and the laminated ores from the sulphide of iron."

337a. ———————

Art. Manganese.

The Mineral Industry, Its Statistics, Technology and Trade. 1892. Vol. I.

(Manganese in Texas), p. 335. N. Y., 1893.

A brief notice of the deposits in the pre-Cambrian rocks of Mason, Llano and San Saba counties.

338. POND, EDWARD J.

A Cretaceous River Bed.

Science, Vol. 9, pp. 536-537. 1887.

An attempt is here made to explain the springs at San Marcos, Hays county, Texas, "where the San Marcos river rises full grown from the earth, with a steadiness of flow in marked contrast with the majority of Texas rivers." The theory advanced, viz.: that the water supply is furnished by the Blanco river through the medium of an ancient Cretaceous river bed, is based upon an opinion ascribed to Professor R. T. Hill (Amer. Jour. of Science, III, Vol. 33, p. 29), that there exists between the earlier Cretaceous strata of Texas and the superimposed rocks a plane of 'nonconformity by erosion' indicating a period of emergence between the two periods of the Cretaceous rock formation.

339. RAGSDALE, G. H.

Evidence of Drift at Gainesville.*

Geol. and Scientific Bull., Vol. 1, No. 7. Houston, Nov., 1888.

"Statements in regard to relations and distribution of gravels of the region." From Darton's Record of N. A. Geol. for 1887, etc., Bull. U. S. Geol. Surv., No. 75, p. 136.

340. RAUFF, HERMANN.

Ueber Porocystis pruniformis, Cragin, (=? Araucarites wardi, Hill) aus der unteren Kreide in Texas.

Neues Jahrbuch für Min., Geol., u. Pal., 1895, Bd. I, pp. 1-15. 1895.

"Diese merkwürdigen Körper hat Robert T. Hill zuerst 1889 erwähnt[1] ([1]A Preliminary annotated check list of the Cretaceous Invertebrate Fossils of Texas, accompanied by a short description of the Lithology and Stratigraphy of the System. Geol. Survey of Texas [Austin], Bull. No. 4, pp. XIV, XVIII [durch einen Druckfehler steht *hier Gadolina* anstatt *Goniolina*]) und zwar als *Goniolina*. Er hat dann 1890 wieder die Aufmerksamkeit darauf gelenkt,[2] ([2]Amer. Jour. of Science and Arts., 3 ser. Bd. 40, pp. 64-65) hat sie 1891 als *Goniolina* oder *Parkeria* aufgeführt[3] ([3]The Comanche Series of the Texas-Arkansas Region. Bull. Geol. Soc. of America. Bd. 2, p. 508. Rochester.) und endlich 1893 als Zapfenfrüchte einer Conifere beschreiben, die wahrscheinlich eina Art von Araucarites wäre.[4] ([4]Paleontology of the Cretaceous Formations of Texas: The invertebrate Palentology of the Trinity Division. Proceed. of the Biolog. Soc. of Washington. Bd. 8, pp. 39-40. Taf. I, Fig. 1a-d. Die Kurze Beschreibung lauted: Spherical cone-like bodies, varying in size from three-quarters to one and one-half inches in diameter; slightly elongate, oblate or depressed at upper end, with well defined circular scar showing attachment to receptacle; surface consists of minute imbricate scales elongate, ovate or sub-diamond shaped, elongated toward upper end, and crowded around receptacular scar; seed minute.) Er nennt sie nun *Araucarites ? Wardi.* Fast gleichzeitig sind sie von F. W. Cragin[1] ([1]A contribution to the invertebrate paleontology of the Texas Cretaceous. Fourth Ann. Report of the Geol. Survey of Texas, 1893, pp. 165-166. Taf. 24, Fig. 2-6) der sie zu den Bryozoen stellt, *porocystis pruniformis* benannt worden."

Beschreibung. Systematische Stellung.

"Alter und Vorkommen.—Nach Hill sehr haüfig in allen Horizonten der Glen Rose-Schichten (Trinity-Stufe), von Glen Rose südwärts bis zum Colorado. In Travis, Burnet, Williamson, Lampasas und anderen counties. Das Gestein ist ein kreidiger, in wenig tiefem Wasser abgelagerter Kalk[1] ([1]In den beiden zur Untersuchung der Radiale hergestellten Dünn-schliffen sind nicht wenige Foraminiferen vorhauden; sie waren aber nicht sicher zu bestimmen). Das Fossil geht aber auch noch etwas höher hinauf, nämlich bis in die unteren Horizonte der Comanche Peak-Gruppe (Fredericksburg-Stufe). Aus diesen führt sie auch Taff von Hickory Cow Creek, Travis County an. Das Alter der Glen Rose Beds is wahrscheinlich tiefstes Neocom. Ueber die Stratigraphie vergleiche:

RAUFF, HERMANN.

Hill, R. T. The Comanche Series of the Texas-Arkansas Region. Bul.. Geol. Soc. of America, Bd. 2, pp. 503-528. Rochester, 1891. Ref. in dies. Jahrb., 1893, II, S. 163—Paleontology of the Trinity Division. Proceed. Biol. Soc. of Washington, Bd. 8, 1893, p. 1 ff.—Ref. in dies. Jahrb., 1894, I, p. 370.

Taff, J. A., Reports on the Cretaceous Area North of the Colorado River. Third Ann|. Rep. Geol. Survey of Texas, 1891. Austin, 1892.—Ref. in dies. Jahrb., 1894, I, p. 150."

341. R. G.

Notes on the Geology of Gaines County.*

Geol. and Scientific Bull., Vol. I. Houston, 1899.

"Reference to occurrence of sandstone, clay, and chalk of economic value." From Darton's Record of N. A. Geol. for 1887, etc., Bull. U. S. Geol. Surv., No. 75, p. 137.

342. ROEMER, FERDINAND.

Ueber eine Durch die Hæufigkeit Hippuriten-Artiger Chamiden Ausgezeichnete Fauna der Oberturonen Kreide von Texas.

Paleontologische Abhandlungen Herausgegeben von W. Dames und E. Kayser, Vierter Band. s. 281-296, Taf. 31-33. Berlin, 1888.

"The fossils described by Prof. Roemer in this article and referred to the Upper Turonian are from the upper part of the Comanche Series of Texas." From C. A. White, Bull. U. S. Geol. Surv., No. 82, p. 51.

342a. ——————

Graptocarcenus Texanus, ein Brachyure aus der oberen Kreide von Texas.

Neues Jahrbuch für Min., Geol., und Pal., 1887, Bd. I, pp. 173-176. Stuttgart, 1887.

"In mehreren grossen Sendungen texanischer Kreideversteinerungen, welche mir in den letzten Jahren durch Herrn Georg Stolley zugegangen sind, befanden sich auch die Exeinplare des nachstehend zu geschreibenden Fossils. Die geringe Zahl der bisher aus den Kreidebildungen bekannten Kurzschwänzigen Krebse begründet ein gewisses Interesse für dieses neue Art."

Description of the specimen. Discussion of its generic position.

"Der Fundort aller vorliegenden Exemplare ist der Shoal creek bei Austin, der Haupstadt des Staates Texas. Das gestein, in welchem sie vorkommen, ist ein fast horizontal abgelagerter, weisser, mergeliger, Kalstein, welcher durch zahlreiche andere Fossilien als der obersten Abtheilung des Turon angehörig bestimmt wird und dem weissen Kalkstein am Guadalupe-Flusse bei Neu Braunfels, dessen fossile Fauna ich in meiner Schrift über die Kreidebildungen von Texas beschreiben habe, im Alter wesentlich gleichsteht."

343. ROEMER, FERDINAND.

Macraster, eine neue Spatangoiden-Gattung aus der Kreide von Texas.

Neues Jahrbuch für Min., Geol., und Pal., 1888, Bd. 1, pp. 191-195. Taf. VI.

The specimens upon which this genus is based were collected by Mr. George Stolley.

Discussion.

"Der Gattungscharakter der neuen Gattung wörde in folgender Weise festzustellen sein.

"*Macraster* nov. gen.

"Die Schale gross, gewölbt, im Umriss hertzförmig. Der Mund auf der flachen Unterseite nahe dem Vorderrande gelegen, quer oval, ohne vorstehende Unterlippe; der After supramarginal, auf einer hinteren Abstumpfungsfläche der Schale. Das Scheitelschild kompakt, mit vier Genital-Poren, die Ambulacren petaloid, unten offen, in Furchen gelegen. Die hinteren Ambulacral-Furchen so lang wie die vorderen. Die Poren der Ambulacren in schmalen quer verlaufenden Spalten oder Schlitzen. Die Oberfläche der Schale mit zerstreut stehenden Kleinen Warzen bedeckt. Keine Fasciolen.

"Die einzige bekannte Art: *M. Texanus* aus oberturonem Kreidemergel von Georgetown, in Texas."

See R. T. Hill "On the Occurrence of *Marcaster Texanus*," No. 207.

344. ROESLER, F. E.

Report of F. E. Roesler, Division and Field Agent for Texas. Submitted with the Report of Richard J. Hinton, Special Agent in Charge of the Preliminary Investigation to determine the proper Location of Artesian Wells within the Area of the Ninety-seventh Meridian and East of the Foot-hills of the Rocky Mountains.)

51st Congress, 1st Session, Senate Ex. Doc., No. 222, pp. 243-319. Washington, 1890.

Artesian Flowing Wells. "West of the ninety-seventh meridian there are, in all, between 650 and 700 flowing wells, ranging in flow from one gallon to 1,000 gallons per minute, and in depth from fifteen feet to 1,852 feet, and in cost from $25 to $7,200. The greatest number of flowing wells are situate in the counties of Bosque, Somervell, Tarrant, and Hood, and in these the average depth is from 200 to 500 feet, a few exceeding this depth. The average flow is between 10 and 20 gallons per minute, a limited number reaching 60 to 100 gallons, and a few exceeding this; some reaching a flow of 300 gallons per minute. The largest wells in the State are those at Waco, five of which jointly flow about 5,000,000 gallons per diem. All of the flowing wells except thirty-one are situate east of the one-hundredth meridian, and as a factor in irrigation at present count for little or nothing. Good, palatable water is found at comparatively shallow depth only east of the ninety-ninth meridian, and north of a line drawn, say, from the southwest corner of Bandera county to Aransas Pass. South of this

Roesler, F. E.

line and west of the ninety-ninth meridian as far as the one-hundredth meridian, all the flowing water obtained from well is impregnated with salt, coal oil, gas, and various compounds of soda, sulphur, gypsum, and is generally unfit for irrigation or any other purpose. The wells east of the ninety-ninth meridian are in material that a non-geologist would locate as underlying the coal measures, while the mineral wells are in the coal measures and partake of all the evil smells and flavors that these strata afford. As a rule good water (flowing wells) can be obtained anywhere east and north of the coal measures at a depth not exceeding 1,000 feet. A flow of 10 to 100 gallons per minute can be obtained at from 200 to 500 feet, with an increase of flow as the depth is increased. South of the line from Bandera county to Aransas Pass, and west of the ninety-ninth meridian, flowing water is found at a depth of 500 to 1,600 feet, but bad water is encountered at 50 to 100 feet, and does not appear to improve at greater depth, though the well-borers and others claim to a man that there is good water in the last deposit of water that was struck in nearly every well that I examined. I confidently believe that there is much truth in the assertion, knowing that until within the past two or three years there was not an apparatus in the State that was adapted to deep borings, and the most of the men were new in the well-boring business, and a majority of failures were due to inexperience and the improper tools used.

"West of the one-hundredth meridian as far as the Pecos river, in what might be called the 'Semi-arid region,' there are a few flowing wells, none of which are over 150 feet deep, and all of which were found accidentally. There are three in Hockley county, one in Dallam county, one in Lubbock, and one in Midland county. The flow from any of them is insignificant, except that in Midland county, and this well is more of a spring or underground stream than a well, presenting a feature not common to the rest of the county.

"In the arid region west of the Pecos river, in Reeves county, there are twenty-six flowing wells. Twenty-four wells are at Pecos City, varying in depth from 185 feet to 300 feet, and in flow from 20 gallons to 300 gallons per minute. Twenty-two miles west of there, at Toyah Station, are two flowing wells, one of which is 832 feet deep. The flow from this well is 300 gallons per minute. The water contains sulphur, but judging from the appearance of a five-acre garden irrigated from it, the water is beneficial rather than otherwise to plant life." Pp. 243-244.

Irrigating Capacity of Flowing Artesian Wells. Remarks. Profit of Artesian Well Investments. Recommendations.

Part II. The Texas Division. That part of the State lying west of the ninety-seventh meridian. Subhumid Region, Dist. No. 1. That part of the State lying between meridians 97 and 100. Altitude of numerous places. Section of the old well on the Capitol Grounds at Austin. Constituents of the water. Modern Flowing Wells. Artesian wells under construction or contract. Artesian Well Failures. Negative Artesian Wells. Numerous Well Sections. Chemical Analyses of Texas Well Water. Railroad Water Supply: Galveston, Harrisburg and San Antonio Railroad Company; Texas Pacific Railway Wells; Gulf, Colorado and Santa Fe Railway; Fort Worth and Denver. Water Supply of Texas Cities and Towns.

ROESLER, F. E.

Semi-arid Region, District No. 2. That part of Texas lying between the one-hundredth and one-hundredth and third meridians north of the Pecos and after its junction with the Rio Grande north of that river to the one-hundredth meridian. List of Railway Stations and their Altitudes. Flowing Artesian Wells. Negative Artesian Wells. Stratification of wells.

District No. 1, Subhumid Region. Flowing Artesian Wells, Common Wells, Lakes, Storage Reservoirs, and other Waters used for irrigation.

District No. 3, Arid Region. That part of the State lying west of the one-hundredth and third meridian and south of the Pecos from its junction with this meridian to its mouth. Railway Stations and their Altitudes. Flowing Artesian Wells at Pecos City. Flowing Wells at Toyah. Other Deep Wells in District No. 3. Stratification of Wells in District No. 3. List of Wells drilled by Lanoria Mesa Company, ten miles northeast of El Paso.

Prices per foot paid for well borings in Texas.

Local Opinions as to the presence or absence of Artesian Waters.

District No. 2, Semi-arid Region.

Springs West of the Ninety-seventh Meridian, District No. 1. Springs in District No. 2.

District No. 3, and Region.

345. ROLKER, CHARLES M.

The Production of Tin in various Parts of the World.

16th Annual Rept. of the U. S. Geol. Surv., Pt. III, pp. 458-538. Washington, 1895.

(Tin in Texas), pp. 528-529.

"In 1889, Professor Theo. B. Comstock announced that he had received a small crystal of cassiterite from Llano county. Later, in the Second Annual Report of the Geological Survey of Texas, Professor Comstock announced the result of his geological examination of the territory in Central Texas likely to prove stanniferous. In this report Dr. W. von Streeruwitz also recorded his discoveries in Western Texas, and to these accounts the reader is referred for detailed information. Professor Comstock points out the fact that the mineral keilhanite (ittrotitanite) is likely to be mistaken for tin, except after close testing, but as it, like garnet, tourmaline, etc., occurs in bands different from those in which cassiterite is found, a knowledge of the structural geology of the district will make prospecting easier." Then follows an account of the belt by Professor Comstock, from which this statement is taken:

"The most favorable points, judging from the knowledge thus far acquired, are in the region about Barringer Hill and westward in Llano county, and in the country about the head waters of Herman and Willow creeks, in Mason county." P. 529.

346. SCHMITZ, E. J.

Copper Ores in the Permian of Texas.

Trans. Amer. Inst. Mining Eng., Vol. XXVI, pp. 97-108. Pittsburg Meeting, Feb., 1896.

"The existence of copper ores in the Permian measures of Texas has long been known, and these ores have been, from time to time, the object of geological researches and mining developments. The most important of these efforts was made about ten years ago by the Grant Belt Copper Company of Texas, but it ended, after several years of fruitless labor, with an entire failure.

"The ore appears principally in two zones of the Permian rocks, namely, the Red River zone in the counties of Archer, Wichita, Montague, Hardeman and Wilbarger, and the Brazos River zone in the counties of Haskell, Baylor, Stonewall and Knox. The above mentioned company prospected mainly through Hardeman, Haskell, Knox and Wilbarger counties.

"From information collected by me, it seems that the geological adviser of the company assumed the copper ore (or at least the copper) to be of plutonic origin, and was directing his efforts towards the depths for the mother-lodes or deposits. The diamond drill was employed for this purpose, and at one point, in Knox county, a hole was sunk to the depth of 1000 feet. How an engineer could conceive the idea that these copper ores of the bedded Permian, which is bare of all plutonic lodes, dikes or intersections, must be of eruptive origin, is rather hard to understand. I have been told that indurated water-worn clay, mistaken for volcanic scoria, suggested or supported the hypothesis.

"The Permian copper ores appear in several horizons in each of the above mentioned zones. In the Red River district, the lower horizon is reported near Belcher, in Montague county. It belongs to the lowest Permian, and lies not much above the line of contact with the underlying Coal Measures. The upper horizon of the Red River district is represented in Archer and Wichita counties, etc.

"The lower copper horizon of the Brazos River zone appears in the counties of Haskell and Baylor, and the upper horizon in Stonewall county, etc.

"It should be remembered here that these horizons are not sharply bound to one continuous stratum or to the same level, as will easily be understood from the fact that the stratification of the Permian measures is somewhat irregular and non-persistent, and that the beds change rather abruptly.

"Of the above mentioned zones, that of Archer county, etc., is one of the most developed, and has been considered as one of the most promising territories; and having had occasion to investigate this district on a short trip during last summer, I hereby lay the principal results before the institute:

"The face of the country is very level, showing only small differences between the flat land and low hills, and the low bluffs (never more than 100 feet high) of the ravines and beds of Wichita River and its branches, the latter being principally the results of erosion during the wet season, while otherwise mostly dry.

"The Permian measures consist of comparatively soft sandstones, clay-

SCHMITZ, E. J.

slates, clays, comparatively soft conglomerates and marls. The occurrences of copper ore are scattered over a large area of Archer and Wichita counties, and the ore of Archer county appears principally in the marls and clay-slates as pseudomorph after wood (cuprified branches of trees, to a thickness of several inches in diameter), and as larger or smaller nodules (up to four or five inches in diameter), most or all of which are of fossiliferous origin.

"Copper ore is found also in irregular amorphous masses, intermixing with and impregnating the marl or clay-slate. In a third form it occurs 'as numerous small pebbles in a hardened cupriferous marl-conglomerate.' And finally I found such nodules of copper ore seated in hardened clay-slate and even in sandstone. The copper ore consists principally of green, blue and dark silicates and carbonates of highly varying percentage. The cuprified wood runs mostly high in copper, generally between 20 and 60 per cent., and the same is true of the nodules. When impregnating or intermixed with the clay and marl, the ore mostly contains less than 20 per cent. of copper; so does the conglomerate, etc.

"No matter in what form the ore appears, it shows always its Neptunic origin. The pseudomorphs of wood, as well as the nodule ores, occur in entirely separate and distinct pieces of irregular form, and are scattered irregularly through the clay or marl matrix, forming nests or pockets of uncertain extent and size. The ore occurrences in the conglomerate marl and the cupriferous clays all show decided pocket-form, and give indisputable evidence of the origin of the copper ores by precipitation during the deposition of the copper-bearing stratum, or by replacement and metamorphosis shortly after the deposition of the strata."

Description of (1) the Isbell Lead seven miles northwest of Archer City; (2) The Ball Mine; (3) The Winn Pocket or Deposit; (4) The Elm Spring District; (5) Other Localities near Isbell; (6) Copper Ore Deposits on Judge Kerr's Farm, two and one-half miles east southeast from Archer City; (7) Spring Mountain, two miles southwest from Arden.

"*Résumé.* The territory examined around the so-called Isbell lead extends about one and one-half miles east and three miles west of Isbell, and about one and one-half miles north and one and one-half miles south, therefore east and west four and one-half miles and north and south about three miles. Copper ore was observed in this district in at least ten different localities in the forms of pseudomorphs of wood, of nuggets or nodules, and as cupriferous marl or clay-slate and clay. The ore appears always in irregular pockets of uncertain position in clay-slate and marl of highly variable thickness; but this clay-slate, etc., and the whole series of Permian measures inclosing the said clay-slate and marl and marl matrix belong undoubtedly in the same geological horizon.

"In the localities two miles south of Archer City we have the copper ore in the clay-slate and as cupriferous marl conglomerate, both apparently of the same geological horizon with the deposits around Isbell.

"The ore in the Texas Permian has this in common with the ore of the *Kupferschiefer* in the German Permian (Mansfield district): that they both occur principally in a bituminous clay-slate and marl; but while

SCHMITZ, E. J.

the copper ores of the former occur prevailingly as separate pieces, nuggets and nodules, collected or grouped to irregular pockets or deposits, the copper ore of the *Kupferschiefer* is concentrated in one continuous thin layer of that formation. Moreover, the copper ores of the Texas Permian are principally carbonates and silicates or silicious carbonates; while those of the German Permian are mostly sulphurets, deposited in very fine particles.

"But somewhat similar conditions must have existed during the process of deposition in both formations."

347. SCIENCE.

Texas Asphaltum.

Vol. XIII, p. 295. Apr. 19, 1889.

See No. 114, Dumble, E. T., "Texas Asphaltum," Geologic and Scientific Bulletin, Vol. I, No. 11, March, 1889.

348. SCOTT, W. B.

A Question of Priority.

(Correspondence.)

Amer. Geologist, Vol. XVII, p. 58. Minneapolis, Jan., 1896.

A statement from Professor Scott concerning the use of "Palo Dura" for certain Tertiary deposits that (unknown to him at the time) had been previously designated by W. F. Cummins, of the Geol. Surv. of Texas, as the "Goodnight beds"; also an explanation of the use of Palo Duro in the Fourth Edition of Dana's Manual of Geology.

"So far as I am aware, the name 'Goodnight beds' has not yet been used by others than Mr. Cummins; it is, therefore, quite within his power to change it for one less objectionable, and it is much to be hoped that he will do so. As the credit of the discovery is entirely his, whatever name he decides to employ will stand." P. 58.

See Title No. 82.

349. SHALER, N. S.

Evidences as to Change of Sea Level.

Bull. Geol. Soc. Amer., Vol. VI, pp. 141-166. 1895.

Reference to Texas, p. 154.

"Beginning the consideration of this continent with the isthmus of Darien and proceeding northward, we observe that the coast line shows little evidence which can be interpreted as indicating flooded valleys, or, in other words, a recent depression of the shore, until we reach the northern limit of Mexico. Then along the eastern side of the continent to the northward the signs indicating recent downward movement appear to me evident and to indicate a progressive subsidence of a uniform nature to near the pole. Reentrant valleys begin to be indicated along the Texas shore."

350. SHUMARD, DR. GEORGE G.

Artesian Water on the Llano Estacado.

Geological Survey of Texas, Bull. No. 1, pp. 9, with 2 sections. Austin, 1892.

The article "entitled 'Artesian Water on the Llano Estacado' was found among the papers of Dr. George G. Shumard, which were loaned to the present survey by his family. I have been unable to find it in print anywhere. Although a very brief statement, it contains facts which are very important in their bearing on the artesian water supply of Western Texas, and it is, therefore, put into this form in order that it may be available." E. T. Dumble in letter of Transmittal.

The Report is addressed to Capt. John Pope, Corps Topographical Engineers, in charge of Pacific Railway Survey, and bears the date of May 1, 1856.

351. SIMONDS, FREDERIC W.

Floating Sand: An unusual Mode of River Transportation (with Table).

Amer. Geologist, Vol. XVII, pp. 29-37. Minneapolis, 1895.

Abstract. Sand, mainly quartzose, was seen floating on the surface of the Llano river at Bessemer, Texas, Aug. 8, 1895. An investigation of the phenomenon followed. Its occurrence elsewhere was ascertained, and experiments undertaken to determine how sand may be floated, what sand will float, and why sand will float. The experiments, which were carefully performed, are minutely described, and the behavior of no less than fourteen different kinds of sand from widely separated localities tabulated. The conclusions reached are grouped under six heads, viz.:

"1. That sand grains will float in perfectly still water for an indefinite time.

"2. That the grains which float are not necessarily silicious. That flakes of mica, fragments of marble, bituminous shale, etc., also float, and that some of them, the marble and the bituminous shale, for example, are unusually buoyant.

"3. That the property of floating is not confined to the sand of any particular locality, but depends to a considerable extent upon the angularity, i. e., shape of the grains.

"4. That whether sand will float or not depends, also, upon the mode of launching, whether it be by ripple waves, as stated by Mr. Graham, or by undermining, it must be gently done, for should the grains be plunged into the water with sufficient force to completely immerse them they will immediately sink.

"5. That the natural conditions necessary to the floating of sand in rivers are somewhat unusual, depending, in the case of the Llano, upon a flood without local rains, and, in that of the Connecticut, upon the manner in which certain waves strike a sand-bar. It is quite possible, however, that floating sand is much more common than is ordinarily supposed.

"6. That the physical explanation of the problem is complex rather

SIMONDS, FREDERIC W.

than simple, and at best unsatisfactory in several important particulars, and that with the advance of molecular physics we may hope for a better understanding of what we now, for convenience, term 'superficial viscosity' and 'capillary attraction.'"

The following conclusions, reached by Mr. James C. Graham in his studies of the floating sand of the Connecticut river (Amer. Jour. Science, III, Vol. XL, p. 476), were confirmed: "That coarse sand can be floated away on a current of far less velocity than 0.4545 miles per hour; and that the phenomena may indicate a possible explanation of the coarse particles of sand found in otherwise very fine deposits."

352 ——————

Floating Sand: An unusual Mode of River Transportation. Scientific American Supplement, Vol. XLI, No. 1048, pp. 16745-16746. Feb. 1, 1896.

A reprint of the preceding (without the table).

353. SIMPSON, CHARLES TORRY.

Description of Four New Triassic Unios from the Staked Plains of Texas.

Proc. U. S. National Museum, Vol. XVIII, pp. 381-385 (with cuts). Washington, 1896.

(This paper was prepared for the Geological Survey of Texas, but on account of the failure of the State to provide for printing further reports of the Survey it was published by the U. S. National Museum.)

"The material upon which this paper is based was sent to the writer for examination by Prof. E. T. Dumble, State Geologist of Texas. It was obtained from the Dockum beds, an extensive formation which underlies all or nearly all of the Staked Plains of Texas and southeastern New Mexico, reaching farther back into that Territory northwest of the Plains, and having some extension under the Cretaceous area south of them in Texas."

The limit of the plains on the east, north and west. The lithologic characters of the beds. Vertebrates shallow fresh water animals as determined by Cope. Unios of Gallinas Creek, New Mexico. Discussion of characters. Description of *Unio sub-planatus*, new species. Locality—"Duck Creek, Dickens County, Texas." Description of *Unio dumblei*, new species. Locality—"Five miles northeast of Dockum, head of Duck Creek, Dickens County." Description of *Unio graciliratus*, new species. Locality—"South of spur, Headquarters 21, Dickens County, Texas; head of Duck Creek, Dickens County." "One right valve of what is probably this species was sent from the Dockum beds, at the southeast corner of Crosby County, Texas, with a number of *U. dockumensis*. Six rather imperfect specimens from the Dockum beds, in the southeast corner of Garza County, Texas, I am inclined to refer to this species, * * *." Description of *Unio dockumensis*, new species. Locality—"Southeast corner of Garza County, Texas; windmill three miles north of Dockum; tank north of Double Mountain River; head of Duck Creek, Dickens County, Texas."

SIMPSON, CHARLES TORRY.

"To sum up, then, these Triassic Unios are evidently not the earliest members of the genus, since they show divergent characters, which are dominant in widely distributed and prominent groups of this genus found living at the present day. Thus *Unio graciliratus*, in its somewhat broken and radiating lines, possesses characters now found in an assemblage of peculiarly sculptured species of eastern Asia, and the teeth of *U. subplanatus* have characters like nearly all the species of the southern hemisphere. The radial beak sculpture is unknown at the present day outside of South America and Australasia, while the forms of at least three of those species, as well as their interiors, where exhibited, bring to mind most strongly the species which now inhabit Europe and western Asia, and a small group belonging to the Mississippi area." P. 385.

354. SINGLEY, J. A.

Report of (for 1891).

Geological Survey of Texas, Second Report of Progress, 1891, pp. 78-82. Austin, 1892.

Contents: Artesian Well Work. Texas Birds. Texas Fishes. Texas Mollusca. The Oyster Industry of Texas.

"I give you herewith a preliminary section of the well (at Galveston) to a depth of two thousand four hundred and twenty-five feet, the depth attained to this date (Dec. 31, 1891). No determinations have yet been made of the many species of the fossil shells, woods, etc., that have been secured, this being deferred until the completion of the well." P. 78.

355. ——————

Preliminary Report on the Artesian Wells of the Gulf Coastal Slope.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 85-113. Austin, 1893.

Contents: Chapter I. The Galveston Deep Well (3070 feet). Galveston Deep Well Section. Chapter II. Artesian Wells of the Coastal Prairie Region and Tertiary Belt of Texas. Galveston City and County: Brush Electric Light and Power Company's Well. Galveston City Railway Company's Wells. Galveston Cotton and Woolen Mill's Wells. Texas Ice and Cold Storage Company's Well. Gulf, Colorado and Santa Fe Railroad Well. National Cotton Oil Company's Well. Bagging Factory Well. Rope and Twine Factory Well. South Galveston Land Company's Wells. Wells on the Main Land: North Galveston. Fairwood Well. Gulf, Colorado and Santa Fe Railroad Company's Well at Hitchcock. J. Tarquard's Well near Hitchcock. Judge R. T. Wheeler's Well near Hitchcock. Nichols' Well, Dickinson. Ramie Farm Well, near Dickinson. Nolan's Well, three miles west of Dickinson. Anderson's Well, near Dickinson. C. C. Petit's Well, near Dickinson. Brazoria County: Alvin Wells. Velasco Well. Well at Surfside. Nueces County: Corpus Christi. Harris County: Wells at Houston, La Porte, Humble, Zimbi. Liberty County: Keno. Polk County: Valda. Fort Bend County:

SINGLEY, J. A.

Arcola. Lee County: Giddings. Bastrop County: Bastrop. Hidalgo County. Robertson County: Calvert, Water, Ice and Electric Light Company's Well, Market House Well, Gibson's Gin, Bremond, Mumford; wells on the Garrett plantation; on the Field's Plantation; E. S. Peter's Well; Well on Burnet's Plantation; on the Astin Plantation. Crinan's Well, at Hearne; Joseph Hearne's Well, at Hearne; Compress Well, at Hearne; Well at Franklin; Well on Westbrook's Plantation; Well at Lewis' Switch; Well on Judge Terrell's Plantation; on Brown's Plantation. Grimes County: Well at Lamb's Spring. Ice Factory Well at Navasota. Brazos County: Well at Steele's Store; Well at Stone City (Mosley's Ferry); Wells at Bryan. Burleson County: Well on William Koppe's Plantation. Harrison County: Well at Marshall. Marion County: Well at Jefferson. DeWitt County: Well at Yorktown. Frio County: T. A. De Vilbiss' Well; T. A. and J. W. De Vilbiss' Wells. Goliad County: Wells seven miles northwest of Goliad. Refugio County: The O'Connor Brothers' Wells. La Salle County: Well at Cotulla. Gonzales County: Wells at Rancho. Victoria County: Wells at or near Victoria. Webb County: Well at Cactus, Laredo. Atascosa County: Pleasanton.

In Chapter I, there is a quotation from the *Engineering News*, Aug. 11, 1892, in which Mr. J. W. Byrnes, a member of the contracting company, gives an account of the well and the method of sinking.

In Chapter II, are given fourteen analyses of water from various places.

356. ——————

Contributions to the Natural History of Texas.
Pt. I. Texas Mollusca.
Pt. II. Texas birds.
Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. II, pp. 299-375. Austin, 1893.

Contents: Part I. A preliminary list of the land, fresh water and marine mollusca of Texas. Terrestrial species. Fluviatile species. Marine species.

Part II. List of birds observed in Lee county, Texas. Notes on the Birds of Galveston Island. List of birds observed at Corpus Christi and on the lower Rio Grande.

357. SMITH, EUGENE A.

Notes on Native Sulphur in Texas.
Science, N. S., Vol. III, No. 70. May 1, 1896.

Location of sulphur deposits. Topography of the region. Geology. The sulphur deposits—their character. Reports of other deposits. Materials filling the basins of the Trans-Pecos region. Sulphur deposits of Sicily. Gypsum. Commercial value of the Texas deposits.

"About forty miles northwest of Pecos City and twenty west of Guadaloupe station, on the Pecos Valley Railroad, are some deposits of sulphur * * *.

SMITH, EUGENE E.

"These deposits occur in the 'Toyah Basin' (or its extension), referred to by Prof. R. T. Hill in his report on the Artesian Waters of Texas. This basin is one of a series of lacustrine formations occupying valleys eroded in the plains or enclosed by mountain blocks, the underlying and enclosing formations being the Red Beds and the lower strata of the Comanche series of the Texas geologists.

* * * * * * *

"At the three places visited by me the sulphur was found below bare, apparently wind-swept spots, its presence being usually indicated either by clusters of gypsum crystals in the soil, or by an outcrop of the sulphur itself, sometimes tolerably pure, sometimes cementing the surface pebbles into a conglomerate. When further exposed by pits the sulphur is seen to occur in nests and irregular veins filling small fissures or crevices in the soil, the sides of these fissures being often lined with well-developed sulphur crystals up to one-fourth of an inch in size. The whole of the earth, to the depth of ten feet or more at the three localities visited, appeared to be impregnated with sulphur, sometimes almost imperceptible to the eye, but oftener in minute crystals concentrated along irregular lines."

358. STANTON, T. W.

"The Columbian Exposition: Notes on Some Mesozoic and Tertiary Exhibits."

Correspondence.

Amer. Geologist, Vol. XIII, pp. 289-290. Minneapolis, 1894.

A reply to an editorial criticism by F. W. Cragin, published in the Am. Geol., Vol. XIII, March 1894, pp. 185-189, relating to the determination of certain species on exhibition by the U. S. Geol. Surv. at the Columbian Exposition.

359. ——————, and VAUGHN, T. WAYLAND.

Section of the Cretaceous at El Paso, Texas.

Amer. Jour. of Science, IV, Vol. I, pp. 21-26. New Haven, Jan., 1896.

"The section here described was made in Mexico and New Mexico near the Initial Monument of the Mexican Boundary Survey, about three miles west of the city. The lowest part of it is exposed in the cutting of the Southern Pacific railroad on the west bank of the Rio Grande, where it cuts the pass through the mountains. The sections extend from here to the top of the hill across the arroyo southeast of the Initial Monument of the Boundary Survey. The rocks are greatly faulted, folded and disturbed by igneous intrusions, so to obtain the sequence and thickness of the beds it was necessary to establish horizons and measure between them where we could find them."

A detailed columnar section covering about 700 feet is given, together with lists of species obtained from the various beds. The paper closes with notes upon the fauna taken as a whole.

360. STERKI, DR. V.

Shells collected in the Sand of a Dry Salt Lake near Eddy, New Mexico.

Third Ann. Rept. of the Geol. of Texas, 1891, pp. 263-265. Austin, 1892.

A list of fourteen species of molluscs with notes.

361. STREERUWITZ, W. H. VON.

Coal in Texas.

Geological and Scientific Bulletin, Vol. I, No. 2. Houston, 1898.

This article is, in the main, an attempt to combat "the prevailing incredulity as to the value of Texas coal deposits."

"Texas has about 25,000 square miles of Carboniferous formation, and that the coal measures of this formation hold good coal is received with the same incredulity as was formerly the assertion of the existence of ores.

* * * * * * *

"Last year I was professionally occupied all summer in tracing the Carboniferous strata in the Chickasaw nation, along the Santa Fe railroad, and I found that the coal formation of the Indian Territory is evidently connected, at least in two places, with that of Texas, but the connecting streaks are mostly covered by thick strata of more recent periods.

"I also found that the Carboniferous strata of Texas show less upheavals coves, and other disturbances than those of the western part of Indian Territory, and that the conditions for the eventual working of the coal in Texas present fewer difficulties on account of water and gas."

362. ——————

Brown Coal or Lignites.

Geological and Scientific Bulletin, Vol. I, No. 3. Houston, July, 1888.

A description of the properties of brown coal or lignite; how it varies from true coal. Methods of utilization as fuel.

"Many of the brown coal deposits of Texas are located conveniently near to railroads, in parts of the State where fire clay, potter's clay and kaolin abound. They are found in the cotton raising counties, and can furnish a cheap and convenient fuel for cotton gins, cotton mills, ceramic factories, etc.

"These deposits, which in places are twenty feet thick, and even more, are in most cases only a few feet below the surface, and consequently the mining is not expensive, no costly shafts, hoisting, pumping and ventilating machinery being required."

Prejudices against the use of lignite.

363. STREERUWITZ, W. H. VON.

Irrigation and Drainage.

Geological and Scientific Bulletin, Vol. I, No. 4. Houston, Aug., 1888.

(Continued in Vol. I, No. 5. Sept., 1888.)

Attention is called to the necessity of irrigation in Texas and to the methods to be employed. Artesian wells, reservoirs, and side canals or ditches to streams are discussed.

364. ——————

Mines worked in Western Texas.

Geological and Scientific Bulletin, Vol. I, No. 12. Houston, April, 1889.

A description of mines in the Trans-Pecos region. The "Shafter mine in the foothills of the south end of the Chanattee mountains." "The material is a strongly ferruginous quartz ore, and calcareous free milling ore with an average assay value of from thirty to thirty-five ounces of silver. The galenites which seem to become more frequent in the deeper strata of the mines are held out and shipped to the smelters."

Description of the mill and processes employed. "The daily output may safely be estimated at from 1000 to 1400 ounces of silver.

* * * * * * *

"The deeper strata of the tremendously large pocket which the company is developing will no doubt consist of sulphurets, and I think it safe to predict that this deposit will be found connected with the numerous lead deposits on the riverside of the south end of the Chanattee mountains."

The Hazel mine "in the Carrizo mountains, at the foot of the Sierra Diablo."

"The gangue is a strongly siliceous limestone, running without a defined wall in bright red sandstone. The gangue is over thirty feet wide at present, with a pay streak vein of about twelve feet. The ore is silver-bearing copper-glanz. Scarcity of water and fuel makes it impossible to work the whole width of the gangue, which, outside of the pay streak, carries about twelve to fifteen ounces of silver to the ton, too low a per centage to ship the material without having it concentrated by washing or smelting to matte. Wire silver is frequently found with the ores in this mine, and pockets of still richer gray copper are struck now and then."

The Bonanza mine, in the Quitman mountains, ten miles from Sierra Blanca station. Vein, two to ten inches of Galena, bearing on an average thirty ounces of silver. The Alice Ray mine. Ores same as those of the Bonanza, viz.: silver bearing galena. "The vein of both mines runs in the contact between porphyry and granite."

365. STREERUWITZ, W. H. VON.

Report of Geologist for Western Texas.

Texas Geol. and Min. Surv., First Rept. of Prog., 1888, pp. 31-43. Austin, 1889.

This report, which is in the form of a diary, is the record of many valuable observations upon topography, economic geology, climate, hydrography, etc., but so numerous and disconnected that a summary is well nigh impossible. The party left El Paso October 11, 1888, and its explorations covered the remainder of that month and the whole of the following.

"As may be seen from this report, I followed the granitic, porphyritic, and crystalline schistose portions of the mountain ranges from Rio Grande, through the Franklin range, through the Quitman, Sierra Blanca, Sierra Carriza, Eagle Spring, Van Horn and Chispa mountains to the Apache range, and through part of this, touching the Sierra Diabolo and some less important ranges. I selected such slopes as had mines or prospects partly developed, and where I could hope to find information and water." P. 43.

366. ————————

Compiled Tables of Rainfall.

Rainfall from 1879 to 1887, at Fort Davis and Surrounding Circle of Country of 100 miles Diameter.

Average Annual Rainfall by Months.

Normal Average Temperature in West Texas.

Texas Geol. and Min. Surv., First Rept. of Prog., 1888. p. 44. Austin, 1889.

Compiled from the Records of the U. S. Signal Office.

367. ————————

Report of.

First Ann. Rept. Geol. Surv. of Texas, 1889, pp. lxxix-lxxxi. Austin, 1890.

Administrative Report. "The portion of the State to which my field work was confined during the year 1889 is that extreme western part, embraced between the Pecos river and Rio Grande, known as Trans-Pecos Texas, and the time I was in the field was devoted principally to preparatory work and determinations which were positively essential to a correct understanding of its geology. For successful geological determinations and investigations of this part of the country, the study of the topography is absolutely required. Eruptive rock, of different periods and character, intrude into and penetrate the sedimentary strata, which are also of different ages, and for the most part strongly metamorphosed.

"The mountain groups and ranges and the hills are separated from each other by wide gaps and extensive flats, filled in with more recent deposits, which add greatly to the complications of the geological work in this part of the State.

STREERUWITZ, W. H. VON.

"Another source of complication arises from the greater erosion of the older mountains by the Cretaceous sea, as well as from later erosions and intrusions, and the covering of these by more recent materials after the Cretaceous deposits were formed." P. lxxix.

Information derived from former reports meagre. Existing maps of doubtful value. Difficulties of running and measuring straight lines. Topographical map a necessity. This work undertaken. Start made at Sierra Blanca. Preliminary base measured. Instructions received to classify mineral lands. Camp at Sierra Blanca Junction. Topography of the Cretaceous Hills. Vertical Distance of Curves 100 feet. Camp at foot of Quitman Mountains. Camp at Eagle Flat. Camp six miles west of Torbert. Base line measured and monuments erected.

368. ——————

Geology of Trans-Pecos Texas. Preliminary Statement. First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 217-235; 2 ills. Austin, 1890.

Contents: Character of country. Sierra Blanca Mountain. Quitman Mountain. Carrizo Mountain. Sierra Diablo. Mineral resources. Agriculture and Irrigation. Development. Conclusions. Topographical notes.

"As has been mentioned, the mountains and hills of Trans-Pecos Texas rise generally (seemingly, at least) in isolated ridges and groups from broad flats, abruptly in most cases, and either without foothills or surrounded only by those of limited extent and height. This is particularly the case with the eruptive mountains.

"But even a superficial examination shows that in spite of the great variety in rock material there exists an essential connection between all of the eruptive mountain ranges and groups, and that the flats and basins between these ranges and groups, however extensive they may be, are in fact deep valleys, having depths of even 1000 feet and more (as has been proved by borings), and filled in with the debris not only of eruptive material, but also with that of Carbonic, Cretaceous, and possibly intermediate strata. This is often covered in turn with Quaternary detritus, which is in some cases more than 100 feet thick.

"In the Quitman Mountains, or at least in their northern part, we have to deal with eruptive rocks only; with granites of at least two ages, and with porphyries, the latter evidently younger than the granites.

"The Sierra Blanca group of mountains rises north of the first ridge of the Quitmans, and is separated from them by a valley two miles in width, which slopes gently from the mountains on either side, and west towards the river. The group consists of four isolated, moderately cone-shaped mountains, the highest of which, the Sierra Blanca Peak, has a height of nearly 7200 feet above the sea level, or 2000 feet above the surrounding flat. Up to the present time no granites similar to those of the Quitman range have been detected in the Sierra Blanca group, and outcrops of dioritic rocks exist which have not been observed in the Quitman Mountains, so far as they have been examined. Porphyritic rocks are

STREERUWITZ, W. H. VON.

found, however, resembling those of the Quitmans. The surface rock of the Sierra Blanca Mountains consists of a quartzitic material in sharp, angular fragments, varying in size from six inches to more than six feet, evidently a metamorphic or semifused sandstone, with occasionally a thin layer of crystals of hornblende. These quartzites, which are broken at nearly right angles to the plane of the original stratification, are devoid of petrefactions or impressions of organic matter. They evidently cover the slopes and summits to considerable depth, coinciding in their present inclination with the mountain slopes. The isolation, character, and peculiar shape of the Sierra Blanca Mountains seem to point to laccolitic intrusions as their origin.

"The four mountain cones of this group are decidedly newer than the Lower Cretaceous rocks surrounding them. The dip of the Lower Cretaceous hills in the vicinity of the Sierra Blanca Mountains is the same as that of the quartzite forming the slopes of these mountains, and the saddle of Lower Cretaceous limestone, with excellently preserved specimens of fossils, lying between two of the mountains, and stratified horizontally, seems to indicate that the upheaval of all the mountains of this group took place simultaneously and probably gradually after its deposition.

"From observations made up to this time no connection can be found between the intrusive material of the Sierra Blanca cones and the eruptive rocks of the nearest or northwestern ridge of the Quitman Mountains, and it will require careful study and comparison with the Quitman Mountains, and the distant ranges and groups to the northward, to justify final conclusions.

"The foothills east and south are Lower Cretaceous, with numerous and extensive porphyritic intrusions. To the west there are more recent (Quaternary?) beds, sloping gently towards the river and intersected by numerous ravines and dry watercourses. The Sierra Blanca Mountains, with their fragment-covered surface, and the foothills west of them, show fewer distinct ore outcrops, and are lacking in the tempting indications of ore deposits and veins found in the Quitmans and their foothills. I regard this plainly visible presence of ore in the Quitman Mountains, and the absence of such distinct indications in the Sierra Blanca group, as an additional evidence that they belong to separate upheavals, independent of each other, and also of the laccolitic character of the Sierra Blanca group." Pp. 219-220.

"In the Quitman Mountains, the Bonanza and Alice Ray mines have shipped some good ores, containing 30 per cent. and over of lead, 25 to 30 per cent. of zinc, with from 20 to 30 ounces of silver, and traces of gold—say an average value of $60 to $65 per ton; * * * ." P. 223.

369. ————

Report of.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. xci-xciv. Austin, 1891.

An administrative report. It deals with the difficulties of carrying on geological work in the Trans-Pecos region on account of the scarcity of

STREERUWITZ, W. H. VON.

water and food for horses. While delayed the services of the party were offered to Dr. R. S. Woodward, Astronomer of the U. S. Geological Survey, who was engaged in taking observations for the final determination of the 105th meridian. The locations of the various camps during the season are given. The work of Mr. Taff, Assistant Geologist, outlined. Mr. Ralph Wyschetzki, Topographer, assisted by Mr. Leon Perl. Other difficulties encountered, such as the want of reliable maps, metamorphism, etc. The necessity of studying the older rocks in New Mexico and Arizona before reaching final conclusions in West Texas set forth. Mineral resources and building stones promise well. The climate, observed during two summers and two winters, the general lay of the land and the quality of the soil lead to the conclusion that "the conditions for a future use of the soils for agricultural and horticultural purposes are anything but hopeless."

370. ——————

Report on the Geology and Mineral Resources of Trans-Pecos Texas.

Chapters I-IV, inclusive. (For Chapter V, see J. A. Taff.)

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 665-713. 3 plates, including one of sections; topographic map. Austin, 1891.

Contents: Chap. I. Definition of area included in the region. Chap. II. Descriptive Geology. Chap. III. Mineral Resources and Irrigation. Hunter district; Bonanza district; Big Gulch or Silver King, district; Zimpleman's Pass district; Sierra Blanca Junction; Eagle Mountains; Hills between the Texas and Pacific Railway and Cliffs of the Sierra Diabolo; Ornamental and Building stones; Irrigation; Development. Chap. IV. Minerals of Trans-Pecos Texas.

"The present Report refers principally to the area mapped, topographically, between longitude 104° 55′ and 105° 35′, and latitude 30° 55′ and 31° 10′, covering the east and west slopes of the Quitman Mountains (formerly Sierra de los Dolores) to the El Paso stage road; the Malone Hills; the southwestern part of the Sierra Blanca group, with Sierra Blanca Peak; the southwestern spur of the Sierra Diabolo; the western part of the Carrizo Mountains; and the northern foothills of the Eagle Mountains (Sierra del Cola del Aguila); the hills of the Devil's Ridge (sometimes called the Devil's Backbone); and the hill ranges between the Sierra Diabolo, Carrizo, Eagle Mountains, and the Quitman Range, with the intervening extensive flats. It refers also, as far as geography is concerned, to a part of Trans-Pecos Texas, which up to this time has not been worked up topographically and geologically, but which I have touched by reconnoitering, such as the Guadaloupe Mountains, extending southward from New Mexico towards the foothills, and northern slope of the Davis (Apache or Limpia) Mountains, between the San Martin Springs and Van Horn.

"This southern extension of the Guadaloupe Mountains, connecting with

STREERUWITZ, W. H. VON.

the Davis Mountains, extends through the Paisano and Mount Ord range to the Sierra St. Jago (Sa. Contrario), which runs down to the Rio Grande, forming the divide between the Pecos (Rio Puerco) and Rio Grande above the mouth of the Maravillas creek." P. 669.

In Chapter IV, the following list of minerals [and rocks], from Trans-Pecos Texas, is given, with notes upon the localities of their occurrence:

QUARTZ—Common; Milky; Granular; Mountain Crystal; Sagenitic Quartz; Adventurine; Flinty Quartz; Smoky Quartz; Agates, banded, cloudy, and milky; Onyx.

AMPHIBOLITE—

HORNBLENDE—

GRANITE—Fine and coarse-grained, red and gray, chloritic, syenitic and ferruginous; granites with garnets and graphite; Talcose granite; Pegmatite; Granulite.

PORPHYRIES—Argylophyre; Melaphyre; Olygophyre; porphyritic trachytes, etc.

MICA SCHISTS—Also Talcose, chloritic, and hornblende schists.

MICA—

FELDSPAR—

MARBLES—Dark gray, coarse-grained; lighter gray, fine-grained; yellow and peach-blossom shades, streaked, and mottled, very fine-grained white and pink; white and purple, etc.

CALCITES—

VOLCANIC ROCKS—Lava, compact and cavernous basalt, basaltic wacke, obsidian, retinite, and trachyte.

SERPENTINE—Brown, oil green, brick-red and mottled.

IRON—Silicious magnitite and hematites; siderite; titanic iron; pyrites; gossan.

LEAD—Galena; carbonates of lead with silver; zinciferous lead ores with silver.

ZINC SULPHIDES (Blende)—Pribramite (cadmiferous blende); marmatite; christophite.

ANTIMONY—

NICKEL—

URANIUM—Torbernite; uranochre; uranpecherz, etc.

COPPER—Copper glanz; tetrahedrite; fahlerz; copper indigo; malachite; azurite; silicates; velvet copper ore; black oxide; red and blue carbonates; brown (red) oxide; peacock ore and pyrites; chrysocolla; atacamite; pseudo-malachite.

MANGANESE—Wad; psilomelane; lampadite; crednerite (manganese and copper); pyrolusite.

SILVER—Native.

GOLD—Traces.

TIN—Traces.

QUICKSILVER ORE—Cinnabarite.

371. STREERUWITZ, W. H. VON.

Texas.

Engineering and Mining Journal, N. Y., Vol. 53, pp. 59-60. New York, Jan. 2, 1892.

In this brief article the author calls attention to the mining districts of Texas, viz.: the Trans-Pecos region and the central district, which includes Llano, Mason, Burnet and parts of Lampasas, Gillespie and other counties. The possibilities of the Trans-Pecos country are especially pointed out. Among the properties worthy of mention are the Shafter mine (ten stamps; silver and galena), the Hazel mine (silver-bearing copper ores—sulphides); the Bonanza and Alice Ray mines (argentiferous lead and zinc sulphides).

372. ———————

On the Precious and other Valuable Metals of Texas.

Transactions of the Texas Academy of Science, Vol. I, No. 1, pp. 19-24. Read Feb. 6, 1892.

Precious metals defined; Occurrence of Gold, Platinum, Silver; Ore Deposits—occurrence and indications; Why Gold may be expected in West Texas and the Central District; Indications of ore deposits in the mountains of the Central District and in the Trans-Pecos portion of the State. Comparison of the two regions: "In the Central District peculiarities of the vegetation show plainly the strike of gangues and veins;" Float ore: Silver-bearing lead and copper in Central District; Gold in Trans-Pecos Texas. The Shafter mine in the Chinatti Mountains—Product free milling silver ore and silver-bearing galena. The Hazel mine in El Paso county. Large body of ore in sight—silver-bearing copper. The Bonanza and Alice Ray mines. Small prospects; Analyses of specimens. Location of prospect with reference to railroad. The want of knowledge concerning Texas and its products; West Texas; Incorrect surveys; The Texas Mining Law; Prospectors; Drawbacks in the mining region; The development of the mineral resources of Trans-Pecos Texas predicted.

373. ———————

Report of (for 1891).

Geological Survey of Texas, Second Report of Progress, 1891, pp. 20-26. Austin, 1892.

Contents: Introduction. Geology. Economic Geology.

"*Mr. E. T. Dumble, State Geologist.*

"DEAR SIR: In obedience to your instructions, I took the field in West Texas May 15, 1891, to proceed with the topography of Trans-Pecos Texas, and to study the geological, and particularly the economical features of that part of the State.

* * * * * * *

"Having met Mr. Goode, of the United States Geological Survey, with two topographical parties in the field to work up the country between the 31st and 32d degrees of latitude, and 105th and 106th degrees of longi-

STREERUWITZ, W. H. VON.

tude, I took advantage of this, stopped the topographical parties inside of these boundaries, and commenced work upon the mineral district of the Carrizo Mountains and southern part of the Sierra Diabolo, with the Hazel mine and numerous outcrops and indications and a few prospects on silver-bearing copper ores. I mapped part of the country and took a number of sections, which will materially assist in the determination of the very extensive field of the crystalline schists and their relation to the plutonic and volcanic eruptive rocks, as well as of the superimposed sedimentary strata." P. 20.

The party under Mr. von Streeruwitz afterwards "reconnoitered the Wiley Mountains, and later the northern portion of the Van Horn Mountains."

374. ———————

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. liii-liv. Austin, 1892.

Administrative report. Field work begun May 15th, 1891. A party was organized with Messrs. Randolph Wyschetzki and Konrad Girsewald as assistants. Meeting Mr. Goode, of the U. S. Geological Survey engaged upon the topography of the country between the 31st and 32d degrees of latitude and the 105th and 106th degrees of longitude, the party remained within these limits to work up the mineral district of the Carrizo mountains and the southern part of the Sierra Diabolo. Silver-copper prospects. Part of the country mapped, and sections made which will assist in the determination of the very extensive field of crystalline schists and their relations to other rocks. Unable to effect an extension of the sections to the Guadaloupe range on account of the worn condition of the outfit and the scarcity of food and water for the animals. Reconnoitered the Wiley mountains, and later the northern end of the Van Horn mountains. Left the field October 4th. Acknowledgments.

375. ———————

Trans-Pecos Texas.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. 381-389. 1 plate. Austin, 1892.

Contents: Geology. Mining. Hazel Mine.

"The country west of the Pecos river, at least west of the divide running from the Guadaloupe mountains down to the Rio Grande and crossing into Mexico, is sharply distinct from the country east of the Pecos river, for although we find in the Central Region (Llano and surrounding counties) granites, crystalline schists, Silurian and Carboniferous rocks, metamorphic material and perhaps Devonian strata, alike or similar to those of Trans-Pecos Texas, here we have to deal with geological problems of a different and far more complicated character. Some, I dare say most, of these problems can and will be understood fully only after the mountains of Old and New Mexico have been studied more in detail, because the chronology and sequence even of local events can be ascertained and understood only by comparing all or most of the features of these localities with each other." P. 383.

In his description of the Hazel mine, situated "about ten miles north of Allamore station, on the Texas and Pacific Railroad," the writer says: "The gangue is nearly perpendicular. Its width to a depth of about 500 feet averages 34 feet, below this depth it widens to over forty feet. Its longitudinal extension may be traced for several miles, and its nearly uniform thickness is ascertained for 1800 feet by the present workings * * *. The gangue is in a fissure between a fine-grained red sandstone of probable Devonian age, which also forms the walls, and which, in the vicinity of the gangue, is more or less metalliferous. The gangue has a whitish grey colored calcareous silicate, more or less impregnated through nearly its whole width with copper and silver sulphide and other metal combinations, and numerous richer veinlets fill the space between the two principal veins known as the north and south veins." Pp. 387-388.

376. ———————

The Nonmetallic Mineral Resources of the State of Texas.
Transactions of the Texas Academy of Science, Vol. I. No. 2, pp. 97-102. Read December 31, 1892.

"The mineral resources of Texas are not confined to the deposits of ores of base and precious metals, but there is in the State an abundance of other minerals, not regarded ores, but nevertheless of great value. Some of these are partly appreciated and utilized, but only to a very limited degree. The existence of others, and that they might be of practical value, is known, but up to the present time they are not utilized; of others still, the existence is known, but their value is not even suspected by the greater part of the people."

The subjects discussed are the Texas Brown Coal; experiments in coking; Brown Coal as fuel; fire clays; kaolin; cement rocks; salt deposits; gypsum deposits; heavy spar; granites and marbles; semi-precious stones.

377. ———————

Trans-Pecos Texas.
Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 139-175. 1 plate of sections. Austin, 1893.

Contents: Introduction. Rocks determined by Dr. Osann. Mineral Resources. Assays of some Trans-Pecos Ores. Artesian Wells, Reservoirs, and Agriculture. Plants. Stratified Rocks. Sections.

"The study of the geological features of Trans-Pecos Texas, from the strictly scientific point of view, needs, more than the study of other mountainous regions, the assistance of the microscope and of the chemical laboratory, because in most cases the connections and continuity of the mountain ranges and groups are covered and hidden by extensive flats and basins filled 1500 and more feet with the debris of older and newer formations." P. 141.

Noticed in Amer. Nat., Vol. XXVIII, March, 1894, p. 263.

378. SWANK, JAMES M.

Art. Iron. Min. Resources of the U. S., 1886. (Iron Production in Texas), p. 33. Washington, 1887.

Table showing the production of Iron in the Southern States from 1880 to 1886.

The production of iron in Texas for 1880 was 2500 short tons. For the remaining years up to and including 1886, see Title No. 380.

379. ————

Art. Iron. Min. Resources of the U. S. for 1887. (Iron Production in Texas), p. 11. Washington, 1888.

In a table showing the production of articles of iron and steel in 1887, Texas is credited with 4,383 short tons of pig iron.

380. ————

Art. Iron. Min. Resources of the U. S., 1888. (Iron Production in Texas), p. 23. Washington, 1890.

From a table showing the comparative production of pig iron in various sections, under the caption "Nine Southern States," the following statistics relative to the iron production of Texas are taken:

STATE.	Pig Iron—Short tons of 2,000 pounds.							
	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Texas	3,000	1,321	2,381	5,140	1,843	3,250	4,383	6,587

381. ————

Art. Iron and Steel. Min. Resources of the U. S., 1889-1890. (Iron Production in Texas), pp. 10, 11 and 17. Washington. 1892.

The production of pig iron in Texas for 1889 and 1890 is given in a table on p. 10. The production of pig iron in Texas for six years, 1885-1890, inclusive, is given in a table on p. 11. For 1889, 4,544 short tons; for 1890, 10,865 short tons. For the remaining four years, see No. 334. In a table on p. 17, showing the production of pig iron in 1888, 1889, 1890 and 1891, Texas is credited with the production of 20,902 short tons in 1891.

382. ————

Art. Twenty Years of Progress in the Manufacture of Iron and Steel in the United States.

Min. Resources of the U. S., 1891.

(Iron Production in Texas), pp. 54-55. Washington, 1893.

The production of iron in Texas, in short tons, is tabulated for the years 1872-1891, inclusive, excepting 1875 and 1878.

383. TAFF, J. A.

Report on the Geology and Mineral Resources of Trans-Pecos Texas.

Chapter V. The Cretaceous Deposits.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 714-738. 1 plate of sections. Austin, 1891.

Contents: Lower Cretaceous series—Trinity division; Fredericksburg division; Washita division. Upper Cretaceous series—Lower Cross Timber or Dakota division; Eagle Ford or Benton Shale division. Concluding remarks.

"The Cretaceous strata which were studied during the present year in El Paso county are embraced within an area of one hundred and eighty square miles, having a width of twelve miles north and south and a length of fifteen miles east and west, with a point one and one-half miles east of Sierra Blanca Junction as the centre of the east side.

"The rocks of this formation appear here principally in apparently detached ranges of hills rising above the general level from three hundred to seven hundred feet, usually having their eastern or northeastern faces quite precipitous, a flat top or mesa of greater or less area, and a gradual slope towards the west or southwest down into the surrounding plain. The connection between these different exposures is generally obscured by the drift of the great flats which stretch around them on every side, and adds much to the difficulty of their study. A glance at the map accompanying this Report will give relative position of the localities to be described." P. 714.

384. ——————

Report of.

Geological Survey of Texas. Second Report of Progress, 1891, pp. 70-77. Austin, 1892.

Contents: Introduction. Work in Southwest Texas. Artesian Water. Building Stones. Soils. Irrigation. Work in Central Texas. Building Material. Road Material. Soils and Marls. Artesian Water. Irrigation.

"The following is intended only as a brief résumé of the principal economic results obtained during the work of the field season of 1891, the details and general geology being left for the Annual Report. The first portion of the season was spent in a reconnaissance of Southwest Texas under instructions to examine the artesian water conditions, more especially south of the Southern Pacific Railway, between Corpus Christi and the Rio Grande. The remainder of the field season was employed in a detailed study of the Cretaceous deposits of Lampasas, Burnet, and Williamson counties, with special reference to their economic values." P. 70.

385. TAFF, J. A.

Report of.

Third Ann. Rept. of the Geol. Surv. of Texas, 1891, pp. lix-lx. Austin, 1892.

Administrative Report. Outline of. Work for the field season of 1891. Acknowledgments.

"It was necessary that further investigations be made upon the geology of the Trinity, Glen Rose, and Paluxy beds, which compose the Bosque division, in order to better determine their stratigraphic and taxonomic relations to each other. Accordingly, I took the field April 15, 1891, and made careful sections across these rocks along the valleys of the Bosque river in Erath, Hamilton and Bosque counties, Brazos river in Parker county, South Fork of Trinity river in Parker county, and the West Fork of Trinity river in Wise county. The work was finished May 8th, 1891, and the results are incorporated in my account of the geology of the Bosque division. * * *

"According to your direction, I * * * began the study of artesian water conditions of Southwest Texas, more especially that portion south of the Southern Pacific Railway. Investigation was taken up along the line of the Mexican National from Corpus Christi to Laredo, beginning May 27th, 1891; thence to Cotulla along the International and Great Northern Railway, and thence up the Nueces and Leona river valleys to Montell, Uvalde county. * * *

"The line of parting between the Upper and Lower Cretaceous was traced from the Nueces river valley to Austin; also a study was made of the Balcones fault, and its line located almost continuously from the Nueces to the Colorado river valleys. Much valuable data were gleaned from the basaltic outbreaks which occur associated with the Balcones fault in the Nueces, Leona, Frio, Hondo, and Medina river valleys. * * *

"After completing the work, I began the study of the Cretaceous system north of the Colorado river in a typical area across Lampasas, Burnet and Williamson counties."

386. ——————

Report on the Cretaceous Area north of the Colorado River. I. The Bosque Division. II. The Lampasas Williamson Section.

Third Ann. Rept. of the Geol. Survey of Texas, 1891, pp. 269-379. 6 plates; 2 figs.; map by J. A. Taff and S. Leverett. Austin, 1892.

Contents: Preface—General Geologic and Petrographic Features. Upper Cretaceous. Lower Cretaceous. Brief Outline of the System North of the Colorado—Lower Cretaceous (Comanche) Series. Upper Cretaceous Series. Part I. The Bosque Division—Introduction. Trinity Sand. Glen Rose (Alternating) Bed. Paluxy Sand Bed. Detailed Section of the Bosque Division. The Colorado Section. Bosque Section. Hood County Section. Correlation with other Sections. The Columnar Sec-

TAFF, J. A.

tions. Bosque and Associated Rocks at St. Joe, Montague County. The Bosque Division and Associated Rocks west of the Main Cretaceous Border. Correlation of the Trinity, Glen Rose and Paluxy Beds.

Part II. The Lampasas-Williamson Section—Introduction. Stratigraphical Geology. Carboniferous Basin at Lampasas. Topography of the Paleozoic Floor West of Lampasas. Hydrography. Bosque Division: Trinity Sand. Glen Rose (Alternating) Beds. Paluxy Sand. Fredericksburg Division: Texana Limestone. Comanche Peak Limestone. Caprina Limestone. Flag Limestone. Austin Marble. Kiamitia Clay. Washita Division: Fort Worth Limestone. Arietina Clay. Vola Limestone. Upper Cretaceous Series: Red River (Lower Cross Timbers) Division. Eagle Ford Shales. Austin Limestone. Blue (Ponderosa) Marl. Columnar Sections. Post-Cretaceous Deposits—Drift of the High Land. Second Bottoms. Economic Geology—Artesian Water. Soils.

387. ————————

Mr. Taff's Reply to Prof. Hill.

Correspondence.

Amer. Geologist, Vol. XI, pp. 128-130. Minneapolis, Feb., 1893.

Mr. Taff here makes a brief reply to that part of Professor Hill's criticism of the Third Texas Report relating to his work (Amer. Geol., X, 394) in which he explains why he employs the term "Bosque" instead of "Trinity," accounts for the similarity between his classification of the "Comanche Series" and that of Professor Hill, and points out the fact that there is a line of demarkation between the Denison and Arietina beds, "as shown by fauna as well as by the strata themselves."

388. ————————, and LEVERETT, S., Assistant.

Report on the Cretaceous Area north of the Colorado River.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 239-354. 1 cut; 4 plates; 2 maps. Austin, 1893.

Contents: Introduction. Chapter I. Fredericksburg Division; Texana Limestone; Cleburne Section, Fort Worth Section. Comanche Peak and Caprina Limestone. Kiamitia Clay; Fauna of the Kiamitia Clay.

Chapter II. Washita Division: Fort Worth Limestone and Denison Marls; Exogyra Arietina and Vola Subdivision, Vola (Shoal Creek) Limestone.

Chapter III. Upper Cretaceous Series: Dakota (Lower Cross Timbers) Formation; Area of Outcrop; Timber Creek Beds; Dakota Formation North of the Denton Section.

Chapter IV. Eagle Ford Formation: Waco Section.

Chapter V. Austin Limestone Formation: Waco Section; Fort Worth Section; Cleburne Section.

Chapter VI. Artesian Water: Catchment Area and Water-bearing Strata. Outline of the Area which will produce Flowing Wells. Lines showing Well Depth. Structure and Position of the Different Rock Sheets

TAFF, J. A.

Governing the Artesian Water Conditions: Trinity Sand, Glen Rose (Alternating) Beds, Paluxy Sand, Fredericksburg and Washita Divisions, Dakota Sands, Eagle Ford Clays, The Austin Limestone. Artesian Basins: The Trinity Artesian Basin. Area of Shallow Wells in the Trinity Basin. The Paluxy Artesian Basin. Area of Artesian Flow on Red River. Dakota Artesian Basin: Dakota Flow in the Brazos River Valley, Artesian Flow in Chambers Creek Valley, Artesian Water in Mountain Creek Valley, Dakota Artesian Water in the Trinity Sands. Springs. Relative Value of Flowing and Non-flowing Wells.

Chapter VII. Soils: Residual Soils of the Comanche Series; Soils of the Texana, Comanche Peak and Caprina Limestones; Soils of the Kiamitia Clay; Soils of the Fort Worth Limestones and Denison Marls; Soils of the Exogyra Arietina and Vola Limestone and Marl; Soils of the Upper Cretaceous: Dakota Sands, Lower Cross Timbers Area; Soils of the Black Land Prairie; Soils of the High Land Drift. Transported Soils: Soils of the Brazos Valley; Soils of the Trinity River Valley; Soils of the Red River Valley; Analyses.

Chapter VIII. Topographic Features and Drainage. Topography of Grand Prairie. Topography of the Black Land Prairie. High Land Drifts. Basal Gravel Drift of the Stream Valleys.

"This report is a continuation of the work begun in the Third Annual Report for 1891 on the geology of the Cretaceous north of the Colorado river. In the report for 1891, the geology of the Bosque division, which is the lowest of the system, was treated of as it occurs through its whole extent north of the Colorado river and the geology of a section of the Cretaceous system between the Colorado and Brazos rivers was also given. The present report takes up the geology in the natural ascending order of the rocks north of the Brazos river, beginning at the base of the Fredericksburg division, where it was left off in the previous work. In their order of succession the Fredericksburg and Washita divisions of the Comanche series were studied, after which the Dakota (Lower Cross Timbers), the Eagle Ford, and basal portions of the Austin limestone formations were taken up and worked in as close detail as was possible in the time alloted." P. 241.

"The work on artesian water is an advance on the knowledge of this subject, in the Texas region, especially in the methods of its presentation. The source of the artesian water and the conditions governing its flow have been studied and discussed, independently, by Mr. Robert T. Hill and the writer; therefore, whatever may be added on this division of the subject is simply an enlargement of former work. In brief, the report on artesian water discusses the subterranean artesian basins with special regard to their sub-areal extent, variations in thickness and water transmitting power, and the deliniations of the areas of flowing and non-flowing wells for each of the three artesian basins, viz.: the Trinity, the Paluxy, and the Lower Cross Timbers, instead of the local disconnected divisions heretofore considered. All of these features are graphically outlined upon the artesian map, or portrayed in the sections, with lines showing approximate depths required for wells to penetrate each artesian basin." P. 242.

389. Tait, J. L.

Gas Well at San Antonio.*

Geol. and Scientific Bull., Vol. 1. Houston, Feb., 1888.

"Record of material passed through in a 373-foot well."

From Darton's Record of N. A. Geol. for 1887, etc., Bull. U. S. Geol. Surv., No. 75, p. 150.

390. ——————

Reports of Geologists for Southern Texas.

Texas Geol. and Min. Surv. First Rept. of Progress, 1888, pp. 64-69. Austin, 1889.

This paper was prepared in accordance with instructions from the State Geologist, directing the author to examine and report on the minerals existing in Edwards, Bandera, Medina, Frio, Atascosa, La Salle, and McMullen counties. This he did with the exception of McMullen county.

Contents: Edwards County: Topography; Formation (Cretaceous); The Soil; Kaolin; Sulphur; Gypsum; Brown Hematite; Lignite.

Bandera County: Lignite; Brown Hematite; Gypsum; Chalk; Soapstone; Brick Clays; Building Stone; Dyke.

Medina County: Lignites; Flagstone; Fire Clay.

Atascosa County: (Lignite); Petroleum.

Bexar County: Brick Clays; Hydraulic Cement; Artesian Wells; (Analysis of Water at Russ Well).

Frio County: Lignite; Pipe Clay; Soapstone; Brine Well; Mineral Waters.

La Salle County: (Steatite); Brine Well; Artesian Well; (Analysis of Water).

391. Tarr, Ralph S.

A Preliminary Report on the Coal Fields of the Colorado River.

First Ann. Rept. of the Geol. Surv. of Texas, 1889, pp. 199-216. Austin, 1890.

Contents: Introduction. Sub-Carboniferous. Carboniferous—Richland sandstone. Milburn division. Brownwood division. Waldrip division. Coleman division. Economics—Coal. Iron. Manganese. Oil, Gas and Salt Water.

"The section covered in this report includes the northwestern portion of Lampasas county, along the Colorado river; about two-thirds of San Saba county, principally north of the San Saba river; McCulloch county north of Brady Creek; the eastern part of Coleman county, from the Colorado as far as Jim Ned Creek; Brown county, east of Pecan Bayou; and the southeastern corner of Mills county. The greater part of this area is underlaid by rocks of the Carboniferous system, and the chief object of the work was to determine the amount of coal, its position in the series, and the relation which it and surrounding rocks bear to each other. The object of this report is to state, in general terms, and as briefly as possible, the most important results of the work, as a preliminary report, to be followed later by a more comprehensive and detailed statement." P. 201.

392. TARR, RALPH S.

Origin of Some Topographic Features of Central Texas. Amer. Jour. of Science, III, Vol. XXXIX, pp. 306-311. New Haven, April, 1890.

"The Central Paleozoic area of Texas is a region of older rocks exposed by the removal of the overlying unconformable Cretaceous. The southern portion of this area has, since the very earliest times, been the seat of extensive denudation as long as any land area remained above the sea. The Potsdam sandstone perhaps derived its sediment from the still older metamorphic rocks. A conglomerate layer in the Lower Carboniferous series contains pebbles from the Silurian rocks. The same is true of the conglomerate in the Upper Carboniferous; and the Trinity beds, the lowest of the Cretaceous system, when conglomeritic, contain, in this region, chiefly Silurian pebbles. The Quaternary drift has the same peculiarity."

The geological history of the region is now given with special reference to the Colorado river drainage.

"The combination of geologic structure and peculiarity of erosion has given rise to three types of topographic outline. First, the rugged hilly topography of the plicated and metamorphosed Silurian rocks, an outline in part descended from an existing Pre-Cretaceous topography. Second, a low hilly Carboniferous area with many broad-topped hills, especially where the Cretaceous has just been removed. On account of the destructibility, this area is being rapidly degraded and the cañon character of the Colorado is therefore rapidly disappearing, and thus destroying the evidence of the recent rejuvenation. Third, the sharp angular outline of the butte and meza type in the Cretaceous area which is rendered possible by the nearly horizontal nature of the beds and the alternation of hard and soft strata, but which has probably been aided also by the rapid erosion which followed the early Quaternary uplift."

393. ———

On the Lower Carboniferous Limestone Series in Central Texas. Amer. Jour. of Science, Vol. XXXIX, p. 404. New Haven, May, 1890.

"Mr. Tarr, in a recent communication to the editors, gives an account of his study of a Paleozoic region in Central Texas which was reported upon by Dr. F. Roemer in 1848 as affording fossils like those of the Carboniferous limestones of the Mississippi Valley. The fossils described were from San Saba county. Mr. Tarr reports that the Paleozoic area covers part of Llano, Mason, Southern San Saba and McCulloch counties. The older rocks in it are much upturned and flexed; and the Silurian limestones are chiefly marble, and have lost their fossils by metamorphism. Carboniferous limestones and shales overlie these beds unconformably, and the Upper Carboniferous consisting of sandstones, shales, clays and limestone, 'attain a thickness in one section of 8,000 feet.'"

394. TARR, RALPH S.

The Carboniferous Area of Central Texas.

Amer. Geologist, Vol. VI, pp. 145-153. Minneapolis, Sept., 1890.

Contents: I. General Statement. 1. Position of the formation. 2. Erosion of the Cretaceous. 3. Boundary of the Carboniferous. a. Probable extent. b. The Silurian area. c. The Lower Carboniferous series. II. Description of the Upper Carboniferous series. 1. Thickness of the series. 2. General stratigraphic relations. 3. Dip of the beds. 4. Division of the series. a. Richland Sandstone. b. Milburn shales. c. Brownwood limestone. d. Waldrip Coal Division. e. Coleman Division. III. Summary.

"The Cretaceous beds in Central Texas have been removed from a portion of the valley of the Colorado and Brazos rivers so as to reveal the underlying Paleozoic rocks. This region, which has been called by Prof. R. T. Hill the Central Denuded Area, consists in its southern portion of a very much disturbed region of older Silurian and Cambrian rocks with granite bosses and possibly Archæan Schists. Unconformably upon this is a belt of lower Carboniferous partly revealed by the erosion of the overlying unconformable upper Carboniferous. Above the latter is Permian.

"Whether the Cretaceous covered all this central area is a mooted question. There seems to be no evidence to the contrary, and Prof. Hill has announced the probability of such former extension. In several places the Cretaceous is found resting on the Silurian; in one place, southwest of the Brady, in McCulloch county, at an elevation of 2,000 feet. As the Cretaceous at this point is of the lowest division (Trinity of Hill), and as Prof. Hill has given evidence that the Cretaceous is in part a deep water formation, there seems to be no question that it once covered all this region, particularly since the entire area is surrounded by a receding Cretaceous bluff. That the Carboniferous has been uncovered from beneath a uniform mantle of Cretaceous strata is evident at first sight. Not only is it surrounded by a receding bluff of Cretaceous, but tongues of Cretaceous strata extend over, and isolated buttes and very much degraded patches remain upon the Carboniferous. The so-called Santa Anna mountains of Coleman county consist of two isolated buttes of Cretaceous rock, in the center of the Carboniferous, separated from the main mass of the Cretaceous on either side by more than fifteen miles." Pp. 145-146.

"The history of the Carboniferous system, as briefly outlined in the preceding pages, commences with the deposition of a considerable thickness of lower Carboniferous limestone on an old shore of Silurian land. An interval accompanied by an elevation, a small amount of disturbance, and probably some erosion, is followed by the opening of the upper Carboniferous. Forty-five hundred feet of sandstone, shales and conglomerate included in the Richland division probably represent the Texas equivalent of the Millstone grit. Following this quite uniform shallow water deposit, was a time of quiet water deposition, during which the Milburn shales were laid down with a total thickness of about 160 feet. A submergence, at least in the southwest, marks the beginning of the Brownwood division,

TARR, RALPH S.

a period of limestone deposit in the southwest, but of more sandy beds to the northwest, which seems to point to the presence of an old land area near there, which is now hidden from view beneath the Cretaceous. The last beds of the Brownwood division indicate a return to shallow water conditions, and this is followed by the coal bearing shale beds of the Waldrip division. Following this is the deposition of alternating clays and limestones, containing much clay and a consequent change in fauna. The conditions of this deposit seem to indicate that the then shore line was in the Carboniferous, and that the Carboniferous beds previously deposited and unconsolidated were in part furnishing sediment for the forming strata. The Permian conditions are probably being approached, and possibly even at this time the basin of deposit has become a partially enclosed sea. A gap of unknown extent ensues after the close of the Permian until the beginning of the Lower Cretaceous which buried the Paleozoic rocks, now by erosion partially uncovered for study." Pp. 152-153.

395 ——————

Superimposition of the Drainage in Central Texas.
Amer. Jour. of Science, III, Vol. XL, pp. 359-362. New Haven, Nov. 1890.

"A superimposed river, having selected its course with reference to a structure now no longer present, naturally finds itself flowing without reference to the nature of the newly discovered beds. Thus it is that the Colorado in Central Texas is now busy with a barrier of hard Silurian rock, and thus it is that this river flows with a general course at right angles to the strike of the Carboniferous rocks in an opposite direction to the dip.

"Not only the Colorado itself, but all its tributaries, flow without special reference to structural weakness; but the smaller branches take advantage of the structural peculiarities, showing, in many cases, that they are more recent in origin than the time of removal of the Cretaceous. Moreover, some of the medium-sized streams, which in their upper and middle course flow, perhaps on Cretaceous, quite regardless of Carboniferous structure, have nearer their mouth partly adjusted themselves to the new conditions. The number of strike valleys in the lower course of such streams is quite astonishing, since it shows to how great an extent drainage is dependent upon structure, and how readily, even under great disadvantages, streams will make use of such weaknesses. In the Carboniferous this is particularly noticeable in valleys carved in soft clays and shale. * * *

"Everywhere may be seen signs of attempts at rejuvenation, but it was not until lately that I was able to see that the Colorado itself shares this peculiarity. This river flows with a very serpentine course through the Carboniferous, having a length along the boundary of San Saba county of fifty miles, while at the end it is only thirty miles from the first point. In one place it makes a bend six miles long where a cut-off would reduce the distance to two miles. Several possible reasons suggest

TARR, RALPH S.

themselves in explanation of this phenomenon, which is quite remarkable in a river with a fall of from two to three feet per mile. Since the Colorado is a superimposed river, flowing in its present course chiefly by accident, it is possible that before the Quaternary uplift the river may have been sufficiently old, in this part of its valley, to have the serpentine course common to such rivers. Thus, the present form of the valley may be inherited from that time. Another possible cause is that the slow removal of the Silurian by retarding the down-cutting in this part of the river-channel has induced a temporary old age condition."

Attempt of the Colorado to readjust itself to new conditions. The evidence. Another unexplained phenomenon is that the divide between the Colorado and the Brazos is close to the latter and far from the former.

"It is probable that both the Brazos and the Colorado originated under practically the same conditions; that is, upon the new Cretaceous land elevated above the sea during the great Tertiary mountain uplift. Their course was plainly chosen with reference to conditions appearing on the surface then existing without regard to what lay below. After cutting through the soft, nearly horizontal Cretaceous rocks, the Colorado came upon the buried Paleozoic and encountered not only the Carboniferous for a considerable distance, but also the much harder Silurian with which it has long been struggling. The Brazos, on the other hand, by the accidental choice of a more easterly course, avoided these difficulties. * * * The consequence of this difference between the two rivers is that while the Colorado in Mills county flows at an elevation of 1,200 feet above the sea level, the Brazos, in the same latitude, has cut down to within 600 feet of the sea level in its soft bed.

"This fact has given the Brazos a great advantage over its competitor, the Colorado, for drainage territory; and this, in the battle for conquest of headwater drainage area, has enabled the Brazos to push the divide close up to the Colorado in territory, which, under more favorable circumstance, should belong to the latter stream."

396. ——————

The Permian of Texas.

Amer. Jour. Science, III, Vol. XLIII, pp. 9-12. New Haven, Jan., 1892.

The existence of Permian in Texas reported by various observers. Conclusive evidence furnished by Professor C. A. White (Am. Nat., Vol. XXIII, p. 109). Facts furnished by Mr. W. F. Cummins (1st and 2nd Repts. Geol. Surv. of Texas), who estimates that Permian strata have a thickness of fully 5,000 feet. "The Permian of Texas occupies a broad, gentle syncline in the Carboniferous, the western arm being a part of the Rocky Mountain uplift. Its present boundaries, and consequently its former extension, have not been ascertained. Many hundred square miles are covered by these strata in the sub-humid and arid belt of Central Texas, the Pecos river forming approximately the western boundary, while on the east the strata do not extend much farther than Abilene." P. 9.

TARR, RALPH S.

Lithological character of the strata: beds of clay, sandstone, and conglomerate, of red color, pale gray limestone, gypsum, and salt. "Most of the beds are unfossiliferous, but Dr. White has described thirty-two species of invertebrate fossils from the Texas Permian, and Prof. Cope fifty-seven species of vertebrates. It is upon this basis that the beds have been referred to the Permian." P. 9.

The object of this paper is "to indicate the sequence of events which have led to deposition of the Permian beds in this district." Pp. 9-10.

397. ——————

Reconnoissance of the Guadaloupe Mountains.

Geol. Surv. of Texas. Bulletin No. 3, pp. 42. Austin, 1892.

Contents: Letter of Transmittal. Preface. Introductory: General Statement; Previous work in the Guadaloupe Mountains.

Part I. Reconnoissance Section across the Permian of Central Texas: Cretaceous Areas; Cretaceous near Marienfield; Carboniferous; Transition from Carboniferous to Permian; Typical Permian; Doubtful Beds near Westbrooke; Erosion at south border of Llano Estacado; Probable Permian near Pecos City.

Part II. Geology of the Guadaloupe Mountains: General Statement. Topographic Features of the Guadaloupe Region: Dark Canyon; Black River; McKitterick Canyon; Pine Canyon; Drainage on west side of the Guadaloupe Mountains; Dog Canyon; Crow Flat Valley; Springs supplied from the Mountains. Stratigraphy of the Guadaloupe Mountains: Possible Correlation; Age of fthe Strata; Monoclinal Structure; Probable Fault; Disturbance; Pre-Cretaceous Erosion; Quaternary Rocks.

Part III. Economics of the Guadaloupe Mountains: Artesian Water; Building Stones; Minerals; Coal. Index.

"The object of this work was to determine the age of the Guadaloupe mountains, their geological structure and relation to the strata east of the mountains with particular reference to the artesian water supply of the Plains, and the prospects of the district for coal and other minerals. Circumstances prevented the completion of these plans and consequently the work was done in much less detail than was at first intended. Instead of four months, as was first planned, only two months were spent in the field and less than one month in the mountains. Furthermore, there being no topographic map of the region, and it being impossible to make detailed observations in consequence, the work has necessarily been general rather than of a detailed nature. For these reasons this report is no more than a reconnoissance. Still, it has been possible to add something to the knowledge of this region, both of the geology and the economic resources as revealed by the geology." P. 9.

398. ——————

The Cretaceous Coverings of the Texas Paleozoic.

Amer. Geologist, Vol. IX, pp. 169-178. Minneapolis, March, 1892.

TARR, RALPH S.

The character and scope of this paper are shown in its opening and closing paragraphs:

"The question as to whether the central Paleozoic and Pre-Paleozoic region of Texas was completely covered by the Cretaceous, is still a mooted question. Prof. R. T. Hill has, at various times, stated that this was the case, giving numerous reasons for the statement; but Dr. T. B. Comstock, who, by his detailed study of the central mineral region of Texas, is well qualified to speak upon the subject from other points of view, has come to the opposite conclusion. In the second annual report of the Texas geological survey he has again stated this conclusion, giving therefor numerous reasons of considerable value.

"A study of the region immediately north of this area has convinced me of the accuracy of Prof. Hill's conclusion, and it is my purpose at this time to place the reasons for this conclusion on record." P. 169.

"In summary it may be said that it has been the attempt of this paper to prove that the central Paleozoic and Pre-Paleozoic core of Texas has been from before the beginning of Carboniferous to Cretaceous times, almost, if not quite uninterruptedly, a land area subjected to denudation; that, at the beginning of Carboniferous times, the land was already eroded beyond the stages of youth nearly to topographic maturity; that; when the Cretaceous period began, it found the Carboniferous area a low-lying, base-leveled area, a peneplain skirting a moderately low and not strikingly diversified highland of older and harder rocks; and that the Cretaceous ocean completely covered this region, depositing thereon a considerable thickness of Cretaceous rocks. The encroachment of the Cretaceous sea was rapid, as is indicated by the peculiar Trinity conglomerate, which is apparently hurriedly worked over land debris. The final chapter in the history was the Post-Cretaceous elevation, which first raised this region above the sea, because its former elevation was in part indicated in the topography of the Cretaceous ocean even through the blanket of Cretaceous strata which covered it. Being the first to be raised above the sea, it was the first to be eroded, and consequently now, over large areas, shows no signs of the former covering, either in remnants, Quaternary debris, or in unadjusted stream courses." P. 178.

399. ————

A Hint with respect to the Origin of Terraces in Glaciated Regions.

Amer. Jour. of Science, III, Vol. XLIV, pp. 59-61. New Haven, July, 1892.

Doubt as to the exact method of formation of terraces in rivers flooded by the melting of the ice sheet, as, for instance, the Connecticut. Some suppose that terraces mark recent erosion in a drift-filled valley; others, that they mark the high stages of floods. The object of this paper is "to record some observations in an entirely different region where the terraces of glaciated regions are being imitated, and where the general conditions are quite similar to those attending the formation of the terraces in

TARR, RALPH S.

glacial regions, as I understand those conditions. I refer to the valley of the Colorado in Central Texas.

"The river is here superimposed upon a hard Silurian barrier which is effectually retarding its downcutting, although the river is still well above base level. One of the effects of this retardation of development on the region upstream from the barrier is that a temporary base level is produced, and the Colorado itself and the side streams are, for a certain distance, actually building up their beds. The effect of the barrier is thus felt for forty or fifty miles; but above this, the flow is rapid and the river is degrading its channel. Along the entire course the side streams are rapidly at work, and from these two sources much sediment is being furnished. Owing to the many soft beds of Cretaceous, Permian and Carboniferous through which these streams are flowing, the amount of sediment supply is very great.

"Another point of importance in this connection is the peculiarity of rainfall. The immediate region is sub-humid, the extreme headwaters are in a truly arid region. Consequently, the water supply, during the greater part of the year, is small in amount; but heavy rains, which are of annual occurrence, and often of greater frequency, bring to the river vast floods of water, which the ordinary channel is totally unable to hold. Almost the entire rainfall has to be carried off, for the barren soil holds but little, and the violence of the rain speedily forms it into rills and rivulets even where no drainage lines previously existed. While this is written chiefly with reference to the arid headwaters it applies almost equally to all the streams, even those of the sub-humid belt. These tributaries, during the greater part of the year, consist of a few pools, often isolated, sometimes connected by a slowly trickling stream. These pools are enclosed commonly in bars or delta bars in the stream channel, formed during flood times, and the violence of these floods is attested by the presence of drift wood lodged in the pecan trees many feet above the low water stage of the stream. In the Colorado these are sometimes at an elevation of fifty feet above the low water surface."

A parallel is now drawn between the conditions here recorded and those existing at the time of the formation of the terrace deposits at the close of the Glacial period.

400. ————————

Notes on the Physical Geography of Texas.

Proceedings of the Acad. of Nat. Sciences, Pt. II, pp. 313-347. Phila., Apr.-Sept., 1893.

Contents: Preface. Part 1. *General Description.* 1. General Geography. (a) Topography. (b) Drainage. 2. General Climatic Conditions. 3. General Geologic and Geographic Development. (a) Pre-Carboniferous Land. (b) Carboniferous modification of the older Paleozoic Land. (c) Jura-Trias Period of Denudation. (d) Cretaceous Subsidence. (e) Post-Cretaceous Changes. (f) Post-Cretaceous Drainage. Part II. *Physiographic Description.* 1. General. 2. The Quaternary Coastal Prairies. (a) Geographic Description. (b) Young, Consequent,

TARR, RALPH S.

and Extended Drainage. (c) Estuarine Conditions. (d) Young, Growing Coast Line. 3. The Rolling, Forested Tertiary Area. (a) Topographic Description. (b) Mature, Consequent and Extended Drainage. (c) Origin of the Flood Plains. (d) Origin of Forests. (e) Rio Grande Embayment. 4. The Cretaceous Grand Prairie. (a) Topographic Description. (b) The Cross Timbers. (c) Rejuvenated Peneplain. 5. Central Paleozoic Denuded Area. (a) Topographic Description. (b) Peculiarities of Creek Erosion. (c) Effect of the Superimposition of the Colorado on the Silurian. (i) Temporary Base Level. (ii) Loss of Drainage Territory. (d) Adjusted Stream Courses. (e) Summary of the History of the Colorado. 6. The Arid Plateau. (a) Topographic Description. (b) River Valleys Abandoned Through Dessication. (c) Aeolian Deposits in the Pecos Valley. 7. The Trans-Pecos Region. (a) Topographic Description. (b) Erosion in the Guadaloupe Mountains. (c) Quaternary Conglomerate. (d) Dessicated Quaternary Lakes. (e) The Rio Grande and Rio Pecos. 8. Absence of large Lakes in Texas. 9. Summary. 10. Bibliography.

"This paper is based in part upon personal observation, in part upon the published results of others. Free use has been made of the results of the several geologists who have studied the Texas region, and in most cases direct reference has been made to the sources of information. I am particularly indebted to the publications of Prof. R. T. Hill for many geological facts and interpretations, chiefly in the Cretaceous regions where this author has done so much valuable work. With few exceptions, however, the work done by others has been geological rather than physiographic, and consequently I have been in many cases forced to rely upon my own observations alone. Since these were made in sections only, it has not been possible in all cases to make the results as definite as could be desired. My observations were made in 1889 and 1890, the time occupied in field work being almost eight months, the larger part of which was spent in the Central Denuded Area. Aside from this and short excursions and railroad journeys, I also made a wagon journey across the State of Texas from north of Austin to the Guadaloupe Mountains in the Trans-Pecos region, and spent several weeks in and about these mountains.

"The results embodied herein must therefore be understood to be the results of reconnoissance,—preliminary exploration of a great and interesting field. Were it possible that in the future I should again have the opportunity of studying the region I would delay the publication still longer; but this seems to be entirely out of the question, and I believe that I am justified in placing the results of my study on record to serve as a possible basis for future work." P. 313.

Noticed in Amer. Nat., Vol. XXVIII, p. 50, Jan., 1894.

401. T. F. L.

Artesian Wells and the Possibility of Irrigating from them.

Geological and Scientific Bulletin, Vol. I, No. 8. Houston, December, 1888.

T. F. L.

Extract.

"I am satisfied, however, that by combining tanks and artesian wells, that part of Texas west of the 97th meridian can be irrigated successfully at about one-half the expense of either the California or Colorado systems.

* * * * * * *

"Our streams generally cannot be depended upon. The ravines running down from our small mountain formations are usually underlaid by joint clay or solid rock, and are well adapted for tanks and small lakes. In nearly all of our valleys artesian wells are obtained at depths ranging from 100 to 600 feet. Indeed, some few wells have been obtained on mountain elevations. One just finished, about five miles from this place [Morgan, Bosque county], yields from thirty to thirty-five gallons per minute, and must be nearly 250 feet above the level of the adjacent creeks. This well is nearly 800 feet deep. There are between one hundred and two hundred wells in this and Somervell counties, yielding all the way from five to one hundred gallons per minute. Two or three such wells would supply the loss from evaporation and seepage, and keep a tank covering from ten to fifty acres full during the dryest years. Such a tank would easily supply sufficient water for several hundred acres."

402. THOMPSON, R. A.

Report on the Soils, Water Supply, and Irrigation of the Colorado Coal Field.

Fourth Ann. Rept. of the Geol. Surv. of Texas, 1892, Pt. I, pp. 447-481. Austin, 1893.

Contents: Soils: Residual Soils; Transported Soils; Alluvial Soils; Analyses of Soils. Timber. Water and Water Supply: Rivers; Creeks and Branches; Springs; Wells; Tanks and Artificial Reservoirs; Artesian Wells; Mineral Water. Irrigation: Irrigable Lands; Methods of obtaining water for irrigating; Dams and Impounding Reservoir Embankments; Rainfall, Tables of Annual Precipitation; Methods of Irrigating; Measurements and Duty of Water.

"The area herein discussed is illustrated on the map, and includes the major portions of Comanche, Brown, Coleman, Runnels, Concho, McCulloch, San Saba, and Mills counties. * * *

"The province of this report will be to discuss in detail the character, distribution, adaptability to certain crops, timber, etc., of the various soils of our district, the extent, nature, etc., of its water and general water supply, and the feasibility of establishing systems of irrigation whereby its 'dry lands' may be reclaimed and those already under cultivation be made more productive, with designs of dams, estimates of the amount of the annual rainfall available for irrigating, etc., and is subsidiary to the general report on the same area by Mr. Drake, to whom I am indebted for general data, materials for analysis, etc., and otherwise assisting me with this report." P. 449.

403. TURNER, HENRY W.

Volcanic Dust in Texas.*

Science, N. S., Vol. I, pp. 453-455. April 26, 1895.

"Gives a description by R. T. Hill of the locality [in the Llano Estacado region] where the material was found, and refers to similar volcanic material from Nebraska, Montana, Idaho, and California." From Week's Bibliog. and Index of N. A. Geol., Pal., etc., Bull. U. S. Geol. Survey, No. 146, p. 75.

404. VAN HISE, CHARLES RICHARD.

Principles of North American Precambrian Geology.

16th Annual Report of the U. S. Geol. Surv., Pt. I, pp. 571-843. Washington, 1895.

(Precambrian Rocks of Texas, pp. 814-815.)

"In Texas is a series of sedimentary rocks, named Llano by Walcott, which consists of alternating beds of shales, slates, sandstones, quartzites, limestones, ferruginous rocks, carbonaceous or graphitic schists, mica-schists, and chlorite-schists. There also occurs in this area granites and gneisses, a part of which are placed as a separate system by Comstock, but are regarded by Walcott as intrusive in the sedimentary rocks. Whether all of the granites and gneisses are intrusive or not, it is agreed by both that the clastic series are cut by numerous eruptives, both basic and acidic, of which granite is the most prominent. Comstock also divides the sedimentary rocks into two series, between which he believes there is an unconformity. Resting upon the deeply eroded pre-Cambrian are the Potsdam Cambrian rocks.

"It is clear that in Texas there is one, and possibly two, series of Algonkian rocks, but whether the Archean is also represented is as yet undetermined. The sedimentary rocks of the Texas area have been correlated by Walcott and Comstock with the Algonkian of the Grand Canyon region."

405 VAUGHAN, T. WAYLAND.

Section of the Eocene at Old Port Caddo Landing, Harrison County, Texas, with Notes on a Collection of Plants from that Locality, by F. H. Knowlton.

Amer. Geologist, Vol. XVI, pp. 304-309. Nov., 1895.

In this paper two sections at Port Caddo are described. The first extends "from the corner of McCathern's field west to the landing on the south side of the road." The second is "a few yards to the north of the road leading from the corner of McCathern's field to the landing, in a ravine near Bonner's spring."

"The interesting part of the above section, aside from the plants, is the interpretation of the phenomena seen in 3 of the first section and 2 of the second. There has certainly been some erosion. Is it only a local unconformity, or do the sands, with the boulders, etc., at the base represent what Mr. McGee has called the Columbian stage? After studying all

Vaughan, T. Wayland.

that he could find at Port Caddo, the writer was not able to reach a positive conclusion, but from the sands apparently passing below other stratified clays, of Eocene type, he is inclined to believe that we have an instance of local unconformity in the Eocene." P. 305.

"The reason for considering the Port Caddo section of Lignitic age is because Mr. Harris, in his report on the geology of southern Arkansas, has indicated the Lignitic-Claiborne as running to the headwaters of the lakes developed along the Red river. His work was based upon both careful paleontologic work and field study." P. 306.

A tabulated list of plants occurring at Port Caddo Landing, Texas; Campbell's Quarry, Cross Lake, La., and two miles north of Mansfield, La., from Lesquereux and Knowlton, are given.

Mr. Knowlton's contribution consists of the list of plants above mentioned in Mr. Vaughan's paper, together with a few brief notes.

406. Walcott, C. D.

Administrative Report.

(Rocks in Burnet, San Saba and Llano Counties, Texas.)

Sixth Ann. Rept., U. S. Geol. Surv., p. 76. 1885.

An announcement of the age of the Paleozoic rocks of Burnet, San Saba, and Llano counties, Texas.

"These were found to be composed of Carboniferous, Lower Silurian, Upper Cambrian, and a series of strata called the Llano group, corresponding to the Grand Cañon and Chuar groups of Northern Arizona. A good series of fossils was collected from the Upper Cambrian or Texas-Potsdam group." P. 76.

407. ——————

Correlation Papers. Cambrian.

(The Cambrian in Texas.)

Bulletin U. S. Geol. Surv., No. 81. Washington, 1891.

The Cambrian Rocks of Texas, pp. 216-219. Roemer on the Cambrian, pp. 216-217. Dr. B. F. Shumard on the same, p. 217. W. P. Jenney and Prof. J. S. Newberry, p. 218. S. B. Buckley, p. 218. C. D. Walcott, p. 218. Prof. T. B. Comstock, pp. 218-219. Paleontology of the Texas Cambrian, pp. 234-235. Sections of Texas Cambrian, and comparison with Arizona, pp. 354-355. Comstock's Classification, p. 355. Problems for investigation, p. 385.

"The information in relation to the Cambrian area of Central Texas, in Llano county, is sufficient for most Geologic purposes, although more detailed information as to the horizontal distribution of the fauna and the presence or absence of the Middle Cambrian fauna is desirable. The principal question, however, is the investigation of the supposed Cambrian in the vicinity of El Paso and the southwestern portion of the State." P. 385.

408. WALCOTT, C. D., and others.

Discussion of Hill's paper on "The Comanche Series of the Texas-Arkansas Region."

Bulletin Geol. Soc. of America, Vol. II, pp. 526-527. 1891.

Mr. C. D. Walcott: "Professor Hill has brought up the question debated by many geologists, whether the Cretaceous and later formations ever extended over the central Paleozoic area of Texas. A few years since I examined the latter rocks of this area and saw the escarpments of the Cretaceous strata facing the central Paleozoic area. As the last report of the Texas State Survey takes the ground that this Paleozoic area was an island in the Cretaceous sea, it is interesting to see how far the facts accord with this theory. From the statements communicated by Professor Hill, and from analogy, it seems that he must be correct, and that the Cretaceous overlapped this central area; otherwise it would now be reduced to base-level by erosion. I should like to hear what the geologists of the Texas State Survey, who are present, have to say about this theory."

Mr. E. T. Dumble: "I am not personally acquainted with the geology of the central area save in a general way. Dr. Comstock, who is in charge of the district, has given in his report some of the reasons why he considers this area to never have been covered with the Cretaceous rocks, among other reasons urging that many points of this area are higher than any points of the surrounding Cretaceous area."

Professor Hill: "Generally, one can look over the Paleozoic area from the Cretaceous escarpment. It may be true that the Paleozoic does, in some places, rise to the level of the Cretaceous escarpment; but it is necessary to have at least 4,000 feet of Cretaceous strata removed to bring the two horizons on a level, and consequently the Paleozoic would require to be at least that much higher than the present escarpment to have been uncovered by the Cretaceous sea."

For the remarks of Dr. Cooper Curtice, see Title No. 83.

409. WALKER, JOSEPH B.

Notes on the Geology of Burnet County.*

Geological and Scientific Bulletin, Vol. I. Houston, Feb., 1889.

"Statements in regard to characteristics, relations, and distribution of the Cretaceous and Carboniferous." From Darton's Record of N. A, Geol. for 1887, etc., Bull. U. S. Geol. Surv., No. 75, p. 161.

410. ——————

Report of.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, p. cii. Austin, 1891.

Administrative report. During the field season of 1890, Mr. Walker was assigned to Panola, Shelby, Nacogdoches, and Rusk counties for the purpose of examining "the quality of the iron ore deposits" and defining "the boundaries of such ores as would probably be of immediate economic value, with 'such observations on the character of the surrounding geologic formations as the time will permit.'

WALKER, JOSEPH B.

"The want of reliable geographic maps, and the fact that no contour maps of this section exist, together with a paucity of local names for many of the 'mountains,' as they are locally called, and the difficulty of finding persons acquainted with the boundaries of the headright surveys, has rendered exact outlining of the ore beds within the allotted time an impossibility, but sufficient data have been obtained to show the location and approximate extent of the beds of iron ore most suitable for manufacturing purposes, while other observed facts will tend to assist in determining the character and relations of the strata to each other, and the period of the formations as a whole." P. cii.

411. ——————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter VII. Panola County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 225-243. Austin, 1891.

Contents: Introduction; Drainage; Surface; Soils. Timber Growth. Iron Ores; Analyses of Iron Ores. Clays; Analyses of Clays. Lignite; Mineral Paint: Asphaltum Brown, Yellow Ochre, Red Ochre, Red Hematite, White Clays. Green Sand. Silicified Wood. Oil. Fresh Water Siliceous Limestone. Sandstone; Glass Sand; Magnetic Sand. Notes on the Stratigraphy of Panola County. Relation of Strata. Twoomy Creek Metamorphic Disturbance. Grand Bluff Disturbance.

"The district composed of Panola, Shelby, Nacogdoches, and Rusk counties, lying between north latitude 31° and 32° 30′ and west longitude 93° 40′ and 95° (examined during the summer of 1890) is mainly between the Sabine river on the northeast and the Angelina River on the southwest. The whole three thousand, four hundred and ninety square miles is included in what is known as the 'Timber Belt' of East Texas.

"The most characteristic feature of the topography of this district is the enormous erosion, which has ploughed out extensive valleys, and left the high hills (buttes) and ridges, locally called 'mountains,' as imposing witnesses of that potent agency. These hills and ridges, covered with forest trees, when viewed from an elevation, do, indeed, present the appearance of mountain ranges.

"For a general description of the geography and topography of East Texas, with notes on the literature of the Tertiary formation, the reader is referred to the preliminary report by Dr. R. A. F. Penrose, Jr., in the First Annual Report of the Geological Survey of Texas, 1889, and to the introductory chapter of this Report on the Iron Ore Districts of East Texas [E. T. Dumble]."

"Panola county has an area of seven hundred and ninety-nine square miles, lying between north latitude 32° and 32° 30′ and west longitude 94° and 94° 40′. It was created by division from Shelby and Harrison counties in 1846." P. 225.

"The county is drained by the Sabine river, which runs through the middle portion, from the northwest corner to the southwest corner." P. 226.

Walker, Joseph B.

* * * * * * *

"The general surface of this country is hilly and undulating. The highest plains, or remnants of the original Tertiary deposition, are in the northwest and southwest portions, where the buttes and ridges, having a trend from a little north of east to a little south of west, have been formed by erosion from the original Tertiary plains. The estimated height of these is from six hundred to seven hundred feet above the present sea level." P. 226.

* * * * * * *

"The top soil of the buttes and ridges is very sandy, probably from the leaching action of rain water. The soil on the sides of these elevations partakes of the nature of the top, mingled with the under stratum of red ferruginated and mottled red and gray clay. The soil on the low lands and alluvial bottoms is composed of a mixture * * * of the finer particles of the other two." P. 226.

* * * * * * *

"In the northwestern part of the county, on the summits of the highest ridges and hills, there are remnants of the original iron ore deposits." P. 228.

412. ————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter VIII. Shelby County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 244-254. Austin, 1891.

Contents: (Location.) Drainage. Surface. Soils. Clays. Fresh Water Silicious Limestone. Lignite. Timber Growth. Iron Ores. Analyses of Iron Ores. Sandstone. Glass Sand. Silicious Iron Pebbles and Iron Gravel. Manganese Nodules (Wad.). Brown Springs. Notes on the Stratigraphy of Shelby county; Disturbance; Relation of Strata.

"This county, lying between north latitude 31° 35′ and 32°, and west longitude 93° 50′ and 94° 30′, has an area of eight hundred and two square miles.

* * * * * * *

"This county is watered and drained on the east by the Sabine river, which forms its eastern boundary, and also the boundary between the State of Texas and the State of Louisiana.

* * * * * * *

"The western and southwestern portions of the county are watered and drained by the Attoyac Bayou, which forms the western boundary of the county.

* * * * * * *

"The high ridges, originally a part of the elevated Tertiary plains, extend, as remnants, from the northwest corner to the central southern boundary, forming the watershed between the tributaries of the Sabine River on the east and the tributaries of the Attoyac Fork of Angelina River on the west."

413. WALKER, JOSEPH B.

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter IX. Rusk County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 255-267. Austin, 1891.

Contents: (Location.) Drainage. Surface. Soils. Clays; Analyses of Clays. Siliceous Limestone. Lignite. Mineral Water. Oil. Greensand Marl; Analyses of Greensand Marl. Timber. Iron Ores; Analyses of Iron Ores. Glass Sand. Orange Sand. Stratigraphy; Relation of Strata.

"The area of this county is 917 square miles, lying between north latitude 31° 51′-32° 25′ and west longitude 94° 25′-94° 58′. It was formed from Nacogdoches county, and organized in 1843, being named in honor of Thomas J. Rusk.

* * * * * * *

"This county is watered and drained in the northern and northeastern portion by the Sabine river and its tributaries. * * * The middle and southwestern portions by the tributaries of the Angelina river. * * *

"The highest elevations are the iron-capped ridges, more particularly in the northern, northeastern, and southern portions of the county. The remainder is hilly and rolling, except the valleys which form the margins of the streams."

414. ——————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter X. Nacogdoches County.

Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 268-286; plate and map. Austin, 1891.

Contents: (Location, Acreage, etc.) Drainage. Surface. Soils. Clays. Silicious Limestone. Lignite. Mineral Water. Mineral Oil. Greensand Marls. Analyses of Greensand Marls. Timber. Iron Ores. Analyses of Iron Ores. Notes on the Stratigraphy of Nacogdoches County. Relation of Strata.

"The area of this county is 974 square miles, lying between north latitude 31° 15′-31° 50′ and west longitude 94° 20′-94° 55′.

"It was one of the original municipalities, and became a county under the same name in 1837.

* * * * * * *

"This county is watered and drained by the Attoyac Bayou (forming the eastern boundary) and its tributaries on the western side.

* * * * * * *

"The highest elevations are in the northwestern and eastern portions of the county, and were originally part of the elevated Tertiary plain, but now eroded into ridges. The remaining portion of the county is mainly broken and rolling upland, except the valleys along the streams.

* * * * * * *

"This county has extensive deposits of clay suitable for making bricks and tiles."

WALKER, JOSEPH B.

* * * * * * *

"Mineral Oil.—The oil-bearing sulphur water spring * * * is located on one of the two tracts of land owned and operated by the Petroleum Prospecting Company. The water, with traces of oil, flows into the little stream adjacent known as Oil Spring Branch, a tributary of Bayou Visitador. In the valley of the stream are the present oil-bearing wells, some thirty in number."

At the time this report was written the company was "only bailing out" the wells semi-weekly and storing the oil.

The same plan was pursued by the Lubricating Oil Company at its wells in the valley of Bayou Visitador, about three or four miles northeast of the oil spring property above mentioned.

415. ——————

Reports on the Iron Ore District of East Texas. Part III. Description of Counties. Chapter XI. Cherokee County.
Second Ann. Rept. of the Geol. Surv. of Texas, 1890, pp. 287-302. Austin, 1891.

Contents: (Location, Acreage, etc.) Drainage. Surface. Soils. Clays. Mineral Paint. Lignite. Analyses of Lignites. Mineral Water; Chalybeate Springs, Sulphur Springs. Mineral Oil. Greensand. Timber. Iron Ore. Analyses of Iron Ores. The Iron Industry at Rusk and Vicinity. Grades of Pig Iron. Average Daily Product in Tons. Analysis of Pig Iron. Analyses of Limestone. Analyses of Furnace Slag. Cost of Materials. The Tassie Belle Furnace. The Star and Crescent Furnace. General Suggestions. The Recent Earthquake. Concluding Remarks.

"The area of this county is 1008 square miles, lying between north latitude 31° 25′-32° 7′ and west longitude 94° 52′-95° 25′.

* * * * * * *

"This county is watered and drained in the north central portion by the west fork of the Angelina river and its tributaries; on the southeast by the Angelina river and its western tributaries. * * * The Neches river forms the western and southern boundary."

For general features and distribution of ores, see Penrose, R. A. F., Jr., First Ann. Rept. Geol. Survey of Texas, pp. 31, 67, etc.

416. WEEKS, JOSEPH D.

Art. Petroleum. Min. Resources of the U. S., 1889-1890. (Petroleum in Texas), pp. 359-361. Washington, 1892.

Conditions similar to those found in Kansas, New Mexico and southern California. Tar springs. Wells in Kansas and Missouri little east of 95th meridian. Texas springs little east of the 94th, some on 93rd and east of it. Petroleum produced in 1889 in Bexar county near San Antonio, between the 98th and 99th meridians. Product of the springs called maltha by the California geologists.

Texas oil a natural lubricator. Gravity. Source and depth of wells. "Sour springs" at Sulphur Springs, Hopkins county. Oil wells at Nacogdoches. Statistics of production in Texas, 1889-1890.

417. WEEKS, JOSEPH D.
Art. Petroleum. Min. Resources of the U. S., 1894.
Nonmetallic Products.
Sixteenth Ann. Rept., U. S. Geological Survey, Part IV.
(Petroleum in Texas), pp. 378-379. Washington, 1895.

"Conditions similar to those found in Kansas, Missouri, and the southern part of California exist in Texas. Springs, known locally as 'tar springs,' are found scattered over various portions of the State, especially in the northeast, southeast and central portions. The oil wells of Kansas and Missouri are found a little east of the 95th meridian of longitude west of Greenwich. The Texas springs are a little to the east of the 94th meridian, and some are also found on the 93rd and east of it. The petroleum produced in Texas is from Bexar county, near San Antonio, about midway between the 98th and 99th meridians. The product of these springs is known locally as petroleum, and is, in this report, so classified, though some geologists, especially those who have been connected with the geological survey of California, insist on calling it maltha. At present, however, they acknowledge that this so-called maltha and petroleum are similar substances. Chemically, they may be; practically, they are not.

"The Texas oil is a natural lubricator of from 28° to 30° gravity, and is said to be found in a conglomerate. The wells are shallow, the oil being struck in various parts of the State at from 125 to 350 feet. The Bexar county wells, which produced the petroleum reported from this State, are about 300 feet deep. As there is but a limited demand for the oil, there is no effort to produce it in large quantities. The producing wells, which are on the ranch of Mr. George Dulnig, were wells that had been drilled originally for water. They were found to yield small quantities of oil and gas. The production of these two wells in 1889 was about four barrels a month. The annual production is from fifty to seventy-five barrels.

"Outside of the oil produced in Bexar county none seems to have been produced in the State on a commercial scale, though reports as to the discovery of oil at various points in Texas are frequent. At Sulphur Springs, in Hopkins county, there are certain so-called 'sour wells,' which produced a few gallons of oil. In 1887 and 1888 considerable excitement was occasioned by the reported striking of oil in Nacogdoches county. The locality was eighty miles southwest of Shreveport. The wells were driven wells, and some oil was obtained at the depth of eighty-five feet; in other cases at a depth of 300 feet. Quite a number of wells were driven in 1887 and 1888, but no petroleum was produced in 1889. The oil produced in Bexar county was used for lubrication.

"The production of petroleum in this State since 1889 has been as follows:

"PRODUCTION OF PETROLEUM IN TEXAS, 1889 TO 1894.

YEARS.	BRLS.
1889	48.
1890	54.
1891	54.
1892	45.
1893	50.
1894	60.

418. WEEKS, JOSEPH D.

Art. Petroleum. Min. Resources of the U. S., 1895.

Nonmetallic Products, except Coal.

Seventeenth Annual Report of the U. S. Geological Survey, Part III (continued).

(Petroleum in Texas), p. 701. Washington, 1896.

"Practically all of the oil produced in the State in 1895 was from the wells of Mr. George Dullnig, near San Antonio, in Bexar county.

"During the year 1895 a well was completed at Sour Lake, Texas, which gave a small supply of 16° lubricating oil. In drilling a well in Corsicana, at a depth of 1,035 feet, an oil sand some twenty feet in thickness was found, and some two and three-fourths barrels of oil per day has been produced. This, however, has been since the 1st of January, 1896, and this production is not, therefore, included in this report."

Production of petroleum in Texas for 1895, fifty barrels.

419. WEITZEL, R. S.

The Coal Field of Texas.

(Abstract of a paper read before the Ohio Institute of Mining Engineers.)

Eng. and Mining Jour., Vol. L, pp. 214-216. 1890.

Outline: The Geological and Mineralogical Survey of Texas, organized in 1888. Knowledge of Texas coal fields obtained from this source and from work done for private parties. Mining done so far quite limited. Extract from the first Report of Progress [p. 19], concerning the number and extent of the coal fields. Reference to W. F. Cummins [*loc. cit.*]. Professor Ashburner quoted [*loc. cit.*]. The old Gordon mine in Palo Pinto county; the Texas and Pacific Coal Company's mines about four miles southwest from Gordon, on the edge of Erath county. "This company owns about 24,000 acres of land, has two mines, both shafts, one 61 feet deep and the other 74 feet deep, each very well equipped with hoisting machinery, and the balance of their plant is very good. They are now producing about 600 tons of coal per day, all of which is taken by the Rio Grande Division of the Texas and Pacific Railroad for locomotive purposes." The Palo Pinto Coal Company's mine. Shaft 45 to 50 feet deep. Output 100 tons per day. "The seam, the No. 1, at the above mentioned mines, ranges from 18 to 30 inches thick, and has one persistent band of slate from ½ to 1 inch thick; the roof is either slate or soapstone, and the floor generally fireclay, though in places it is sandstone. The State report does not give any analysis of the coal, and the only published analysis of it I have seen shows it heavy in ash and sulphur, and corresponding very closely to the coal of Leavenworth, Kan."

Mine ten miles west of Decatur. Coal used locally. Mine four miles west of Bowie. Seam 30 inches thick, "with a clay parting 3 inches thick." Reference to Prof. Cummins regarding seam No. 7, and various places about Cisco.

"The Nueces or Semi-bituminous field lies in the southwestern part of the State bordering on Mexico." Area not less than 3,700 miles. Northern

WEITZEL, R. S.

boundary not determined. Two or three workable seams. "The upper seam (or middle one, as I understand, where three seams exist), is from 18 to 58 inches thick, with a 2-inch slate parting in the center, and is being worked at San Tomas." Opinion of J. Owen concerning the coal. "The lower seam in this field outcrops 4½ feet at Eagle Pass, several miles northwest of San Tomas and up the Rio Grande river, showing along both sides of the river for a distance of ten miles. The abrupt inclination of the stratum at this place carries it below the surface, and its eastern boundary could not be determined. The stratigraphical position of this seam is 600 to 700 feet below the Nueces or San Tomas seam." Reference to Mr. Owen's measurements at the Hartz mines.

The Lignitic Field. Reference to State Geologist Dumble. See First Rept. of Progress, Geol. and Min. Surv. of Texas, p. 20.

420. W. H.

The Dykes of Bandera County.

Geological and Scientific Bulletin, Vol. I, No. 8. Houston, Dec., 1888.

Description of a pyrite-bearing dyke near Bandera.

Extract: "This vein or dyke is known to run in a straight line about twenty-five or thirty miles, and there are beside it six or seven more running parallel with it, and a line ten miles long north and south would cut all of them."

421. WHITE, CHARLES A.

On the Age of the Coal found in the Region traversed by the Rio Grande.

Amer. Jour. of Science, III, Vol. XXXIII, pp. 18-20. New Haven, Jan., 1887.

"During the past few years many discoveries of coal have been made within the region which is traversed by the lower portion of the Rio Grande, besides those which were made by the members of the United States and Mexican Boundary Commission and other early government expeditions. In Texas, coal has been found in Webb, Maverick, Presidio and El Paso counties; and in Mexico, in the States of Nuevo Leon and Coahuila. By certain local geologists and mining experts, whose reports have fallen under my observation, a part of these coals have been referred to Carboniferous age, and others to Triassic age. From personal examination in the field, extending over a large part of the region in question, and an examination of fossils which have been collected by different persons from strata associated with the coals, I am satisfied, however, that none of them are earlier than late Cretaceous age.

"In some cases the coal of this region is worthless for practical use, but in others it is of good quality; all of it having the general characteristics of the coals which are obtained from the Laramie and Fox Hills formations in Colorado, Utah, and Wyoming. From the data and observations just mentioned I do not hesitate to refer all the known coal of the region under consideration to one or the other, or both, of those formations."

WHITE, CHARLES A.

Intimate association of these two formations in the region of the Lower Rio Grande. No evidence at present of the Laramie in Webb and Maverick counties. The coal found there belongs to the equivalent of the Fox Hills group. The mines at San Tomas, forty miles above Laredo, and those seven miles above Eagle Pass are the principal ones on the Texas side. In Mexico the equivalent of the latter coal is found a few miles from Piedras Negras. From data furnished by Mr. James T. Gardiner, it was ascertained that the Laramie and Fox Hills formations exist in the State of Nuevo Leon and the eastern part of the State of Coahuila. Both of these formations were found by the writer (White) in the region of Coahuila drained by the Rio Sabinas.

Little is known of the character of the coal deposits in the southern part of Presidio and El Paso counties, Texas.

422. ————————

On New Generic Forms of Cretaceous Mollusca and their Relation to Other Forms.

Proc. Acad. of Nat. Sci., Phila., Pt. I, pp. 32-37; pl. II. Jan.-Apr., 1887

"The type species of the three generic forms which are described in this article belong to the collections of Cretaceous fossils from Texas, which I am now preparing for publication in one of the memoirs of the U. S. Geological Survey. In their generic characteristics all three of them appear to be respectively identical with certain forms which have long been known, but which have been referred to other genera by different authors. The features which I now present as having generic value seem to have been overlooked by those authors, or, so far as they were observed, they were treated as specific characters. Two of these forms belong to the section Melininae of the family Aviculidae. The other is referred to the Crassatellidae, but it departs considerably from the typical section of that family."

Crassatellidae. Genus Stearnsia (gen. nov.). Stearnsia Robinsi (sp. nov.). Aviculidae. Genus Dalliconcha (gen. nov.). Genus Aguileria (gen. nov.). A. Cumminsi (sp. nov.).

423. ————————

On the Cretaceous Formations of Texas, and their Relation to those of other Portions of North America.

Proceedings Acad. of Nat. Sci., Phil., Pt. I, pp. 39-47. Jan.-Apr., 1887.

"The true relations of the different Cretaceous formations which have long been known to exist within the State of Texas to each other, and to those which have been recognized in other portions of North America, have not hitherto been satisfactorily known. Several eminent geologists have written upon the subject, and considerable diversity of opinion has prevailed among them. The former impracticability of obtaining information by personal observation over any considerable portion of that region;

WHITE, CHARLES A.

the destruction by the Civil War of the work so well begun by Dr. Shumard, and the limited knowledge then possessed by any one of the general geology of North America, were doubtless the causes which prevented a satisfactory solution of this question."

The author's investigation of the Texas Cretaceous. Field work in charge of Mr. Robert T. Hill, chief assistant. The general section of the Cretaceous strata of the eastern half of Texas which resulted from these labors: Comanche Series—1, Dinosaur Sands; 2, Fredericksburg Division; 3, Washita Division. Gulf Series—4, Timber Creek Beds; 5, Eagle Ford Shales; 6, Austin Limestone; 7, Navarro Beds.

Table showing the equivalency of these formations: Mississippi Section; Texas Section; Western Section; Upper Missouri River Section. The Mississippi section is that of Prof. E. W. Hilgard; the Western is a modification, first proposed by King, of the Upper Missouri river section of Meek and Hayden. White's modification. The New Mexico section by Prof. Newberry. The Fox Hills group. The separate identity of the Dakota group. Facts seem to indicate "that while the greater part of the Dakota group, as it is now known, is a non-marine deposit, we ought to expect to find it to merge into a marine deposit to the southward.

"Now, in making comparisons of the Texas Cretaceous rocks with those which have been observed in other parts of the continent, we find that the whole Comanche series represents older strata than are included in any other published sections of North American Cretaceous except that perhaps of California. The strata of the Comanche series are known to extend northward from Texas into the Indian Territory, and some of its characteristic fossils have been found in southeastern Kansas. Fossils belonging to this series have also been found at various points in Western Texas and the adjacent southeastern part of New Mexico. They have also been found at various points in Mexico, one locality being upon the western side of the Sierra Madre in the Mexican State of Sonora.

"Judging from all the information that I have been able to obtain, I infer that none of the strata of the Comanche series extend beyond the eastern boundaries of Texas, nor further northward than southern Kansas. It seems probable, also, that while this series is well developed, both faunally and stratigraphically, in Texas, it has, or originally had, its greatest development within the region which is now the Republic of Mexico." P. 43.

Discussion of the equivalency of formation. The Timber Creek beds equivalent, at least in part, with the Dakota of the Western and Upper Missouri sections; the Eagle Ford shales equivalent with the bluish shales or lower part of the Colorado group and stratigraphically with the Tombigbee sands; the Austin limestone equivalent with the Rotten limestone of the Mississippi section; the Navarro beds equivalent with the Ripley; and the Fox Hills group of the Western section is recognized in the valley of the Rio Grande in West Texas. "Of the present, or former, direct stratigraphical continuity of the western Fox Hills strata with their presumed equivalents in Eastern Texas, and in the Gulf and Atlantic coast regions, present evidence is not so clear."

Relation of Fox Hills strata and the Navarro Beds to overlying forma-

WHITE, CHARLES A.

tions. Lignite Tertiary Beds of Eastern Texas rest upon the Navarro Beds, but actual contact in East Texas seems not to have been seen by a competent observer. Strata of the Fox Hills group in the region of the Rio Grande are overlaid by those of the Laramie without a sharply defined plane of demarkation. "No equivalent of the Jurassic strata * * * have been recognized in connection with the Texas Cretaceous section as given in this article; and they seem to have entirely thinned out before reaching the region of Central Texas. In that region, the strata next underlying the Comanche series are clearly either those of the Carboniferous or of the Red Beds. The latter are not known to exist to the eastward of the Carboniferous area of Northern Central Texas, but they reach considerable thickness upon the western side of that area, where they are usually known as the Gypsum formation.

"It appears from the investigations upon which this article is based that certain of the members of the Texas Cretaceous section have not heretofore been recognized, and that the true order of superposition of the formations has been misunderstood, the theoretical section of Marcou being more nearly correct than any heretofore published." Correlation of the Upper Series with the Western and Upper Missouri sections; and, in part, with the Cretaceous formations of the Gulf and Atlantic coast. Work of Shumard and Roemer.

424. ——————

On the Relation of the Laramie Group to Earlier and Later Formations.

Amer. Jour. of Science, III, Vol. XXXV, pp. 432-438. New Haven, June, 1888.

The relation of the Laramie group to the Tertiary and to the Cretaceous. The conflicting evidence.

"During the twelve years preceding the autumn of 1887, in which I had made extensive studies and observations concerning the Laramie group, I was never able to obtain any personal knowledge of the actual stratigraphical relation of that group to any of the marine Tertiary groups which border various portions of North America.

* * * * * * *

"In 1884, Professor E. D. Cope announced that he had found 'the Claiborne beds resting immediately upon the Laramie at Laredo,' Texas; but he then mentioned no correlated facts in support of this important announcement, and, so far as I am aware, none have since been published. The known southeastward trend of the Laramie, and the circling, and therefore converging, trend of the Gulf series of formations made it evident that the district traversed by the lower Rio Grande would be found to be the most promising field in which to search for the stratigraphical relation between the Laramie and the Eocene Tertiary. With this object in view, I, last autumn, visited that region, and had the satisfaction of confirming the observation previously made by Professor Cope."

The journey from Eagle Pass to Laredo. The coal beds above Laredo

WHITE, CHARLES A.

referred to the Laramie. Stratigraphical geology on the Mexican side of the Rio Grande. Uncertainty of the precise position in the geological series of the Eocene beds resting upon the Laramie near Laredo. Position of the lignitic beds in Mississippi and Eastern Texas. The "Belly River Series" of Dawson, and its relation to the Laramie. The presumptive evidence of the Cretaceous age of the Laramie.

425. ——————

(On the Fauna of the Permian of Baylor, Archer and Wichita Counties, Texas.)*

Amer. Naturalist, Vol. XXII, p. 926. 1888.

"Statement of his opinion in regard to the Permian age of the formation." From Darton's Record of N. A. Geol. for 1887, etc., Bull. U. S. Geol. Surv. No. 75, p. 164.

426. ——————

On the Permian Formation of Texas.

Amer. Naturalist, Vol. XXIII, pp. 109-128; pl. 1. Feb., 1889.

Cope, from time to time during the past ten years, has published descriptions of vertebrate remains from Texas which he has referred to the Permian; other authors have generally referred the formation to the Triassic. A collection of invertebrates made by W. F. Cummins proved so interesting that the author in company with Mr. Cummins visited the region and made collections and observations personally. He says: "Thirty-two species of invertebrates were collected, about one-half of which were readily recognized as well-known Coal-measure species, but a few of them were new, among which were two belonging to mesozoic types. It is this paleontological feature in connection with important correlated facts, that especially excited my interest in the formation from which the fossils were obtained.

* * * * * * *

"In Texas this formation occupies an area many hundred square miles in extent, which constitutes the western part of the southern extremity of the great central paleozoic region of the continent. The southern boundary of this area is not now definitely known, but it lies at least as far south as the Concho river. Its eastern boundary may be approximately designated as extending from Red river to the Colorado through Clay, Young, Shackleford, Callahan and Runnels counties; and its western border as extending from the Canadian river to the Concho through Hemphill, Wheeler, Donley, Briscoe, Motley, Dickens, Garza, Borden and Howard counties. The formation is known to extend northward far within the Indian Territory, but in this article special reference is made only to that portion of it which is found in Texas; and the description which is herein given is drawn mainly from observations made in Baylor, Archer and other contiguous counties.

"This formation rests directly and conformably upon another series of

WHITE, CHARLES A.

strata in which a characteristic Coal-measure fauna prevails, but which is not known to contain any fossils of the mesozoic types, if we except the *Ammonites parkeri* of Heilprin, which he states was obtained from Carboniferous strata in Wise county. Notwithstanding the mesozoic character of a part of the molluscan fauna of the upper formation, the preponderance of evidence makes it necessary to regard it as belonging to the great Carboniferous system, and as constituting an upper member of it. For these and other reasons yet to be stated I have little or no hesitancy in designating this Texan formation as Permian, as Prof. Cope has done, but I shall briefly discuss in following paragraphs the propriety of the use of that name for all of the North American strata to which it has been applied." Pp. 109-110.

Permian strata blend with those of the Coal-measures. Description of the Texas Permian strata. Topography. Thickness of Permian strata. Vertebrate fossils. Thickness of Texas Coal-measures. Their characteristic invertebrate fossils. The "gypsum-bearing" beds—Triassic or Permian? The great conformable series of North Texas. Thickness. Stratigraphic relations of the Texas Permian. Description of Texas Permian. List of invertebrate species. Summary. Brief descriptions of three new Cephalopod species (Plate I). Commingling of Mesozoic and Paleozoic types.

"The special interest which these Texan collections possess lies, first, in the presence of the two Cephalopods of the Mesozoic type as members of an invertebrate fauna composed otherwise of paleozoic types; and second, in the association of this invertebrate fauna with a vertebrate fauna composed mainly of Permian types, as determined by Professor Cope, and in the known superposition of the formation containing these faunas upon characteristic Coal-measure strata." Pp. 119-120.

The biological interdelimitation of the Mesozoic and Paleozoic ages. Attempts to explain the commingling of earlier and later types in one and the same stratum. Unphilosophical views concerning chronological restriction. Discussion of North American and European Permian.

"The recognition of the Permian of Texas as a separate upper group of strata belonging to the Carboniferous system is based upon both stratigraphical and Paleontological evidence, and this evidence is fuller than that which has been adduced in favor of any other reputed Permian strata of North America." P. 126.

427. ————

Administrative Report, Division of Mesozoic Paleontology.
Eighth Annual Report of the U. S. Geol. Surv., Part I, pp. 178-181. Washington, 1889.
(Field Work in Texas), pp. 179-180.

Instructions to Mr. Hill. "His work for the season was confined mainly to Grayson, Denton, Tarrant, Dallas, Comanche and Travis counties, but various other counties were visited.

Early in October I joined Mr. Hill at Austin and proceeded to review with him his field of work of the two preceding months and to make additional observations with reference to the objects of that work. In

White, Charles A.

futherance of these objects I traversed the western portion of the State along several extended lines and gathered important data there, especially concerning the relation of the Cretaceous formations, which are continuous with those of the Rocky Mountain region to the northward, to those in eastern Texas, which are continuous with the Cretaceous formations of the other Gulf States to the eastward. During this reconnaissance various points along the valley of the Rio Grande were visited, and the formations which were especially under investigation were in some instances traced into the Republic of Mexico for the purpose of making the observations more complete. From these observations, in connection with others previously made, general conclusions have been reached, of which the following is a brief statement.

The Cretaceous series of Eastern Texas is separable into two principal divisions, an upper and a lower, each having distinct and well-marked Paleontological characteristics. A study of their fossil faunas respectively has shown that while the formations of the upper division may be correlated, at least in a general way, with the Cretaceous formations of the great interior region, and also with those of the Gulf States, the lower division cannot be so correlated; that is, the lower division belongs to a lower horizon than that of any other Cretaceous strata of North America at present known, except the older Cretaceous strata of the Pacific coast and perhaps those of the yet comparatively little known Potomac group of the Atlantic coast. Strata of the lower division of the Texas Cretaceous have not been recognized to the eastward of that State, nor farther northward than southeastern Kansas, but they extend to western Texas and over into Mexico, where they are overlaid by the representatives of the Dakota, Colorado, Fox Hills and Laramie groups, as they are overlaid by the formations of the upper division in eastern Texas." Pp. 179-180.

Correlation of the upper division of the Texas series. Plan of work in Texas. Collections of fossils.

428. ————

The Lower Cretaceous of the Southwest and its Relation to the Underlying and Overlying Formations.

Amer. Jour. of Science, III, Vol. XXXVIII, pp. 440-445. New Haven, Dec., 1889.

The Cretaceous strata of Texas referable to two divisions: Upper and Lower. Not necessarily equivalent to European section of the same name. The upper Missouri river section of Meek and Hayden, including the Dakota group, represents the Upper Division; the Comanche series the Lower. Strata of the Lower Division not discovered east of the 65th meridian. With the probable exception of a locality in Central Kansas none have been found north of the southern part of Indian Territory and the southwest part of Arkansas. They exist in the extreme southern part of New Mexico. Fossils from near Arivechi, Sonora, indicate Lower Cretaceous. This is the most westerly locality. The Lower Cretaceous of California contains a different fauna, and is not referred to here. Other exposures in Mexico. Greatest development of Lower Cretaceous strata in

WHITE, CHARLES A.

northern Mexico. More abundant collections of fossils have been obtained in Texas than elsewhere. Contrast between the Lower Cretaceous of the Southwest and the Upper Cretaceous. The Paleontological contrast. Want of faunal relationship between the Upper and Lower Divisions. The chronological hiatus. The Comanche of Lower Silurian strata of Texas east of the Pecos River; Character and Thickness. The same west of the Pecos and in Mexico. Displacements involving other strata. Stratigraphic structure of the Sierra San Carlos in Chihuahua. Structure of the Chinate Mountains of Texas. No satisfactory proof that the Jura and Trias are represented by any North American strata south of the 34th parallel of latitude.

429. ——————

Remarks on the Cretaceous of Northern Mexico.

Proc. Amer. Assoc. Adv. of Science, Vol. XXXVIII, p. 252. 1890.

"In these remarks the speaker referred to observations made during his late visit to the State of Chihuahua, Mexico, and to the adjacent parts of Texas and New Mexico. A small range of mountains in Chihuahua, seventy-five miles southeastward from Presidio del Norte, known as the Sierra San Carlos, was found to be composed almost wholly of much disturbed, compact, bluish limestone strata having the usual aspect of the Carboniferous limestones of the great interior region. They were found, however, to contain Cretaceous fossils from top to bottom, the recognized species being such as characterize the Comanche Cretaceous of Texas. * * *

"The isolated mountain near Presidio del Norte was also found to be composed of the Comanche limestone; and lying upturned against its southern base and extending far to the southward, is a great thickness of shaly strata, succeeded by sandstones, the former bearing fossils of the Colorado Group, and the latter those of the Pierre-Fox Hill Group. * * *

"In the Chinate mountains in Texas, about twenty-five miles north of Presidio, the bluish Comanche limestone rests conformably upon Carboniferous limestone, the color and character of both being so similar that they are distinguishable only by their respective fossils. Here of course both the Jura and the Trias are absent. In both the Chinate and the San Carlos mountains, the Comanche limestone is silver-bearing at its base."

430. ——————

Administrative Report, Division of Mesozoic Invertebrates.

Ninth Annual Report of the U. S. Geological Surv., pp. 120-123. Washington, 1890.

Field investigations in Texas, p. 120-121.

"From the city of Dallas as a center, I extended these field observations into the neighboring counties of Tarrant, Denton, Kaufman and Navarro. This work consisted of an investigation of the stratigraphic relations of the formations occurring in that region with one another and with those of

WHITE, CHARLES A.

other regions; and it also embraced a study of their paleontological characteristics.

"The special object of this work was to ascertain as clearly as possible the relation between the Cretaceous formations which occur in Texas with those which are found to the eastward, westward and northward of that region respectively. The result has been in a high degree satisfactory, but much yet remains to be done in that connection. I was able, on paleontological grounds, to correlate the upper formations of the Cretaceous series in that part of Texas with the Rotten Limestone and Ripley formations of Mississippi and Alabama with an unexpected degree of clearness. Besides this, a part of the series beneath these upper formations are now regarded with nearly equal confidence as equivalent with certain of the formations of western Texas and of the great interior region which stretches to the northward. * * *

"From Dallas I proceeded to Eagle Pass, for the purpose of ascertaining, if possible, the relation of the southern continuation of the great Laramie group with the marine Tertiary formation of the Gulf coast region. * * * The strata exposed in the hills about Eagle Pass, which consist mainly of sandstones, but which bear one or more beds of coal there, I had previously correlated with the Fox Hills group of the Cretaceous series which so extensively prevails to the northward. These strata were found to dip gradually in the direction of the course of the river and to receive upon them those of the Laramie group. The strata of the Laramie group were found well exposed along the banks of the Rio Grande, from twenty-five to thirty miles above Laredo, where, like the underlying formation, they contain one or more workable beds of coal. They also occur on the Mexican side of the Rio Grande, where characteristic Laramie fossils have been found.

"These Laramie strata on both sides of the Rio Grande were found to dip gently to the southeastward, as the underlying formation had been seen to do, and to receive upon them, in the neighborhood of Laredo, sandy strata, which bear an abundance of characteristic marine Eocene fossils."

431. ———————

Administrative Report, Mesozoic Division of Invertebrate Paleontology.

Tenth Ann. Report of the U. S. Geological Survey, Part I, pp. 162-165. Washington, 1890.

Description of the work of this division for the year ending June 30, 1889. An examination of strata in Baylor, Archer and Wichita counties in Texas "which had been reported as bearing a commingling of Paleozoic and Mesozoic types of fossils.

"These strata were found to constitute an important formation, occupying an area of many thousand square miles in extent, in western Texas and in the Indian Territory. It is the same formation that some geologists have referred to the Permian and some to the 'Permo-Carboniferous,' and upon some geological maps it is represented as of Triassic age.

* * * * * * *

WHITE, CHARLES A.

The results of these examinations may be briefly stated as follows: "Far the larger part of the fossils obtained from that formation, many of which are vertebrate remains, are of Paleozoic types, and many of the invertebrates are of well-known Coal-measure species. A few of the inver- of one and the same fauna. The commingling of Mesozoic and Paleozoic forms in such a manner as to leave no doubt that they are all members of one and the same fauna. The commingling of Paleozoic and Mesozoic types in these Texan strata is similar in character to that of the well-known fauna of the Productus limestone of the Salt Range in India.

"This series of Texan strata is lithologically distinguishable from, but blends with and is entirely conformable upon, the underlying Coal-measure series. * * *

"After summing up the results of these investigations, together with those of other observers, I reached the conclusion that for taxonomic purposes the strata in question are properly referable to the Permian."

The intimate relations between the North American Permian and Carboniferous.

Investigation of Cretaceous areas in Southwest Texas.

"These examinations were carried through Comal, Bexar, Medina and Uvalde counties, and the result, together with that of the examinations made last year in the valley of the Rio Grande, was to confirm my previous belief as to the intimate relation of the Cretaceous formations of the Gulf coast with those of the interior region. So many species of fossils have now been identified in both these regions and in the intervening Texan area that there seems no longer room for doubt that the Ripley group of the Gulf States was not only identical with the eastern Texan formation to which the same name has been applied, but that it was originally, if not even now, a deposit continuous with the Eagle Pass formation in the Rio Grande Valley. It is also just as evident that the latter was a deposit continuous with the Fox Hills—Fort Pierre Group of the interior region. Again, it is quite as evident that the 'rotten limestone' formation of the Gulf States is represented in Texas by the Austin limestone and the Eagle Ford shales together; and that the latter together represent the Colorado group of the interior region.

"The field examinations of the past season in Texas also confirm my previous opinion that the marine formation in the northern part of the State, which I have called the Timber Creek beds, represents the Dakota group of the interior region, and that the whole group, which to the northward is a non-marine deposit, becomes wholly marine to the south, where it loses much of its identity as a separate formation."

Mr. Boyle's bibliographic work upon Cretaceous formations and Mesozoic invertebrates.

Publications.

432. WHITE, CHARLES A.

Administrative Report, Mesozoic Division of Invertebrate Paleontology.

Eleventh Annual Report of the United States Geological Survey, Part I. Geology, p. 107. Washington, 1890.

Under the caption "Field Work" mention is made of the continuation of field observations in the southwest, which, in Texas, embraced the region about Presidio on the Rio Grande. Mr. Stanton accompanied Dr. White.

433. ———

The Texan Permian and its Mesozoic Types of Fossils.

Bulletin U. S. Geol. Surv., No. 77, pp. 51; 4 plates. Washington, 1891.

Contents: Letter of Transmittal. Synopsis of Results. Introduction. Description of species. General Discussion. Index.

"Synopsis of results. In this bulletin is presented a summary of the various kinds of evidence that properly may be accepted as indicating the Permian age of a certain series of strata in Western Texas, which have been by some geologists referred to the Trias, and by others to the Permian.

"It also contains an announcement of the discovery in those strata of certain types of invertebrate fossils which usually are regarded as indicative of their Mesozoic age, commingled with a considerable number of Carboniferous types. A large proportion of the latter forms are well-known Coal-measure species.

"All these species are illustrated on accompanying plates, and some of them are described as new. This discovery is the first of the kind that has been published concerning North American strata, but it is similar in character to those made by Waagen in India, Gemmellario in Sicily, and Karpinsky in Russia.

"The paleontological balance which is indicated by this commingling of earlier and later types in the Texan strata is treated as an item of evidence in favor of their Permian age."

The closing portion of the bulletin is devoted to a general discussion of the subject of the existence of the Permian in North America.

434. ———

The Texan Region.

Correlation Papers. Cretaceous.

Bulletin U. S. Geol. Surv., No. 82, pp. 114-130. Washington, 1891.

Boundaries of the Texan Region arbitrary: shown on map opposite p. 72. Area embraces portions of Missouri, Arkansas and Louisiana, a part of Indian Territory, and much the greater part of Texas. The relations of the Cretaceous deposits of the eastern and central parts of the continent may be observed here. Important deposits found not known in eastern and northern parts of the continent. The region is nearly divided by the southern prolongation of the great interior Paleozoic area. Surface of the

WHITE, CHARLES A.

western portion of Texas more diversified than the eastern, containing few mountainous elevations, hills of circumdenudation and valleys. Rocks of the Texan region are Cretaceous, Tertiary and Post-Tertiary. Cretaceous strata are limestones and sandstones more or less compact. Unconformity between Upper and Lower Cretaceous strongly marked in some localities. Dip of Cretaceous east of the Paleozoic area is towards the Gulf or the Tertiary embayment; west of that area there is a generally westerly dip. Structural geology. List of Cretaceous formations in Texas. The Laramie recognized only in western Texas, in the valleys of the Rio Grande and the Nueces. Eagle Pass beds upon which the Laramie rests regarded as equivalent to the Ripley formation and Fox Hill strata. A section—Description of the members composing it. The Trinity formation, originally designated as *Dinosaur* Sands. Placed provisionally with the Cretaceous and assigned to the horizon of the Potomac and Tuscaloosa Formations. The Comanche Series stands alone. Separated by a time-hiatus from the formation above and below. Its greatest thickness is in the North Mexican region. The Timber Creek Formation. Lowest strata of the Upper Cretaceous. Its molluscan fossils are all marine and different from those of the Comanche series. The Timber Creek Formation, probably the equivalent of Tombigbee Sands and possibly of the Raritan and Amboy Clays. The Eagle Ford Formation. Approximately equivalent to Fort Benton Shales and as probably equivalent to the lower part of the Rotten Limestone of the Gulf States and to the Clay Marl of New Jersey. The Austin Formation or Austin-Dallas Chalk. Its upper layers merge gradually into clayey or marly layers which in eastern Texas pass into strata that bear an abundance of characteristic fossils of the Ripley Formation. The "Ripley" strata of Texas. The time-hiatus between the Cretaceous and the Tertiary. A comparison of the Cretaceous Formations of east and west Texas. Diagram showing the interrelations of the Texas Formations. A comparison of the Cretaceous Formations of the Atlantic and Gulf border regions and the Texas Cretaceous. Diagram.

435. ——————

Discussion of Mr. Hill's paper on "The Comanche Series of the Texas-Arkansas Region."

Bulletin Geol. Soc. of America, Vol. II, p. 525. 1891.

Dr. C. A. White: "The Trinity Beds, to which Mr. Hill refers as lying at the base of the Comanche series, I have, in a work now in press, provisionally referred to the base of the North American Lower Cretaceous. They contain, besides some undetermined dinosaurian remains, a few species of non-marine mollusca; but I am at present unable to say whether these forms are more suggestive of Cretaceous than of Jurassic age.

"The fossils which Mr. Hill has exhibited as coming from strata beneath the Comanche I am at present unable to specifically identify. If they really came from the horizon indicated, I think they represent a hitherto unknown molluscan fauna, and that they are of very great interest.

"I quite agree with Mr. Hill in the opinion that the different subdivisions of the Texan Cretaceous cannot be definitely correlated with subdivisions

WHITE, CHARLES A.

of the European Cretaceous. I also think that the assumption of such correlations as have been published, by various authors both in Europe and America, is much to be deplored, because it retards rather than advances true scientific knowledge. For example, the venerable and distinguished Professor Roemer, of Breslau, who has published so much upon the fossils of the Texan Cretaceous, and who knows the paleontology of the European Cretaceous as well as any person living, has referred a collection of Comanche species to the Upper Turonian. He does not merely say that the forms which he published are analogous to those of that subdivision of the European Cretaceous, but he refers them definitely to the same, as if it were as clearly recognizable here as in Europe. On the other hand, the Dakota group, after the early claims that its flora indicate Tertiary age subsided, has by common consent among a large number of geologists been regarded as of Cenomanian age.

"Comparatively late investigations have shown that strata equivalent to the Dakota group in Texas not only overlie the Comanche series, but that there is a wide time-hiatus and unconformity between them; that is, the assumed correlations referred to above place one assemblage of strata far beneath another when in reality its true place is far above."

Diagramatic illustrations.

436. WHITE, I. C.

Fossil Plants of the Wichita or Permian Beds of Texas.

Bulletin of the Geol. Soc. Amer., Vol. III, pp. 217-218. 1892.

Remarks by E. T. Dumble.

Ib., p. 459.

The plants were collected by Mr. W. F. Cummins from the Wichita Beds along with an invertebrate fauna assigned by Dr. C. A. White to the Permian and vertebrate remains assigned by Cope to the same age. They were sent the author for examination by Mr. E. T. Dumble, State Geologist. A cursory inspection showed them to be identical with or very near relatives of plants found in West Virginia above the Waynesburg Coal—Permian of White and Fontaine. By Professor White the plants were sent to Professor Wm. M. Fontaine who wrote: "I am decidedly of the opinion that this Texas flora is essentially the same as the flora described by us in report PP of the Second Geological Survey of Pennsylvania [The Permian or Upper Carboniferous flora of West Virginia and Southwest Pennsylvania]. The *Walchia* is the only important determinable plant not present in the flora of West Virginia and Pennsylvania."

437. WHITFIELD, J. E., and MERRILL, G. P.

The Fayette County, Texas, Meteorite.

Amer. Jour. of Science, III, Vol. XXXVI, pp. 113-119.

New Haven, August, 1888.

An account of the finding of this meteorite at Bluff, a settlement on the Colorado river, three miles southwest of LaGrange, Fayette county, Texas.

Description and analyses of the stone which belongs to the class of "chondrites."

438. WILLIAMS, ALBERT, JR., Editor.

Art. Useful Minerals of the United States. Min. Resources of the U. S., 1887.

(Minerals mined in Texas), pp. 792-793. Washington, 1888.
(Mineral not mined in Texas), pp. 793-794.

A tabulated list of minerals, alphabetically arranged, giving mineralogical name, common name and remarks on each species. Under the latter are included localities and, in some instances, extent of deposits, use, etc.

The following minerals are "mined" in Texas: Clay, Coal, var. bituminous; Coal, var. lignite; Halite (salt); Kaolinite; Limestone; Sandstone; Silver. The following minerals are "not mined" in Texas: Agate; Amethyst; Asbestos; Bismuth ore; Chalcedony; Chalcocite; Feldspar; Galenite; Garnet; Granite; Gypsum; Ilmenite; Jasper; Limonite; Magnetite; Marble; "Molybdenum ore"; Nitre; Obsidian; Ochre; Opal; Petroleum; Pyrite; Pyrolusite; Slate; Talc; Tourmaline.

439. WILLIAMS, J. FRANCIS.

Igneous Rocks of Texas.

Ann. Rept. of the Geol. Surv. of Arkansas for 1890, Vol. II, pp. 5-6. Little Rock, 1891.

A brief notice of the work of Messrs. Hill and Kemp (See Pilot Knob: A Marine Cretaceous Volcano, by Robert T. Hill, with notes on its Petrography by J. F. Kemp. Amer. Geol., vol. VI, p. 286). Allusion is also made to the Pre-Cambrian rocks of the Central Mineral Region as described by Comstock. (See First Ann. Rept. of the Geol. Surv. of Texas, p. 239.)

440. WOOLMAN, LEWIS and KAIN, C. HENRY.

(List of Species found in a "Fresh Water Diatomaceous Deposit from the Staked Plains".)

Amer. Naturalist, Vol. XXVI, pp. 505-506. June, 1892.

"The following number of species, twenty-seven in number, though not exhaustive, is nearly so:

Amphora ovalis Ehr.; *Amphora uncinatum* Ehr.; *Achnanthes ventricosa* Ehr.; *Campylodiscus clypeus* Ehr.; *Cymbella cistula* Hempr.; *Cymbella lanceolatum* Ehr.; *Denticula valida* Pediceno; *Epithemia gibba* (Ehr.) Kutz; *Epithemia gibba* var. *parallela* Grim.; *Epithemia zebra* Ehr., Kutz; *Epithemia gibberula* (Ehr.), Kutz var. *producta* Grim.; *Epithemia constricta* Breb; *Encyonema ventricosum* Kutz; *Gomphonema clavatum* Ehr.; *Fragillaria virescens*, Ralfs.; *Navicula major* Kutz; *Navicula viridis* Kutz; *Navicula rostrata* Ehr. *forma minor; Navicula bohemica* Ehr.; *Navicula elliptica* var. *minutissum* Grim.; *Navicula decurrens; Navicula varians* Greg.; *Navicula brebisonii* Kutz; *Navicula forma* Kutz; *Nitzchia brebissonia* Wsm.; *Nitzschia spectabilis* (Ehr.), Ralfs.; *Surrirella geroltii* var."

See Title No. 6.

ADDITIONAL CITATIONS.

441. BIRKENBINE, JOHN.
Art. Iron Ores.
Report on Mineral Industries in the U. S. at the Eleventh Census, 1890.
(Product and Value of Iron Ore in Texas, 1889), p. 4. Washington, 1892.

Extract from a table showing the "Product and Value of Iron Ore in 1889, by States and Territories":

(Long Tons.)

STATES.	Number of Mines reporting.	Number of Mines producing.	Amount produced.	Stock on hand Jan. 1, 1889.	Stock on hand Jan. 1. 1890.	Total value of production.	Value per ton.
Texas	3	2	13,000	200	4,300	$ 19,750	$ 1 52

442. (DAY, DAVID T.)
Art. Tin.
Report on Mineral Industries in the U. S., at the Eleventh Census, 1890.
(Tin in Texas), p. 251. Washington 1892.

An announcement of the discovery of cassiterite in Llano and Mason counties by Professor Theodore B. Comstock.

443. DAY, WILLIAM C.
Art. Stone.
Report on Mineral Industries in the U. S., at the Eleventh Census, 1890.
(Production of Granite in Texas), p. 603. Washington, 1892.

Extract from a table showing the "Production of Granite in the United States for the Calendar year 1889, by States and Territories":

STATES AND TERRITORIES.	Number of firms producing in 1889.	Number of quarries.	Product.	
			Cubic feet.	Total value.
Texas	8	8	20,400	$ 22,550

444. ———————

Art. Stone.

Report on Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Production of Limestone in Texas, 1889), p. 632. Washington, 1892.

Extract from a table showing the "Production of Limestone in 1889, by States and Territories":

STATES AND TERRITORIES.	Number of quarries	Total Value.	Building Purposes.			Lime.		
			Cubic feet.	Value.	Value per cubic foot.	Barrels (200 lbs)	Value.	Value per bbl.
Texas...........	18	$217,835	666,160	$135,901	$ 0 20	12,000	$ 6,700	$ 0 56

445. ———————

Art. Stone.

Report on the Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Production of Sandstone in Texas, 1889), p. 647. Washington, 1892.

Extract from a table showing the "Production of Sandstone in the United States in 1889":

STATES AND TERRITORIES.	Number of quarries.	Production.	
		Cubic feet.	Value.
Texas..	7	180,591	$ 14,651

446. FLEMING, H. S.

Art. Coal.

The Mineral Industry, Its Statistics, Technology and Trade, 1893. Vol. II.

(Coal in Texas), pp. 214, 216, 217. N. Y., 1894.

In a table on page 214 showing "Bituminous Coal Fields" Texas is credited with an area of 4,500 square miles.

On page 216 the following statements are made concerning Texas: "The coal fields of Texas are extremely important from an economic standpoint, but, while the field covers a considerable area, variously estimated between 4,000 and 15,000 square miles, the coal thus far found has been generally high in sulphur.

"The lignite fields are far more extensive that the coal area. Four distinct seams have been recognized, varying from three to fifteen and even twenty feet in thickness, though the latter figures are exceptional. A coal

FLEMING, H. S.

basin but recently opened in Texas is in the Cretaceous formation on the Rio Grande, near Eagle Pass. This is a continuation of the coal field in Mexico in which the Hondo mines are operating, and so far has shown encouraging results."

The following statistics are taken from a table on page 217:

STATE.	1892.			1893.		
	Net tons.	Value per ton.	Total value.	Net tons.	Value per ton.	Total value.
Texas	300,000	$ 2 25	$ 675,000	322,745	$ 2 00 *	$ 645,490

* Bituminous Coal, $2.25; Lignite, $1.75.

447. HOBART, FREDERICK.

Art. Coal.

The Mineral Industry, Its Statistics, Technology and Trade, 1894, Vol. III.

(Production of Coal in Texas), p. 130. N. Y., 1895.

The following statistics are from a table entitled "Total Production of Coal and Coke in the United States":

(In tons of 2000 pounds.)

STATES.	Coal.					
	1893.			1894.		
	Tons.	Value.	Value per ton.	Tons.	Value.	Value per ton.
Texas	322,745	$ 645,490	$ 2 00	469,409	$ 1,000,895	$ 2 13

See Title 315 for comparison of estimates.

448. ——————

Art. Gold and Silver.

The Mineral Industry, etc., 1895, Vol. IV.

(The Production of Silver in Texas), p. 288. N. Y., 1896.

In a table showing the production of gold and silver in the United States by States, Texas is credited with 429,314 fine ounces of silver valued at $270,468 for 1894, and 529,974 fine ounces of silver valued at $346,073 for 1895.

449. JONES, JOHN H.

Art. Coal.

Report on Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Statistics of Coal Mining in Texas), p. 347. Washington, 1892.

JONES, JOHN H.

Extract from a table entitled "General Statistics of Coal Mining in the United States at the Eleventh Census":

STATE.	Mines.		Total production of coal in 1889 (short tons).	Total amount received for coal.	Average price per ton.
	Regular.	Local.			
Texas	4	6	128,216	$ 340,620	$ 2 66

450. PEALE, ALBERT C.

Art. Mineral Waters.

Report on the Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Production of Mineral Waters in Texas, 1889), p. 779. Washington, 1892.

Extract from a table showing the "Production of Mineral Waters for 1889, by States and Territories":

STATES AND TERRITORIES.	Number of springs reporting.	Product (gallons).	Value of product.	Capital invested.
Texas	14	213,700	$ 10,354	$ 66,440

451. RIES, HEINRICH.

Art. Clay.

The Mineral Industry, Its Statistics, Technology and Trade, Vol. II, 1893.

(Clays in Texas), pp. 203-204. N. Y., 1894.

Reference to brick produced at Austin, cream to yellow; the mottled brick of East Texas and the Carboniferous area; the high grade brick at Rusk and New Birmingham. "During 1889 the production of the State was 95,000,000 bricks." The Tertiary clays suitable for drain, tile and terra cotta. The fine clay of Fayette, Henderson and Limestone counties. The Athens fire brick. The blue sandy clay near Marshall and pottery clays near Jefferson. Reference to W. Kennedy (See Title No. 275, Report on Grimes, Brazos and Robertson counties. Fourth Ann. Rept. Geol. Surv. of Texas, 1892, pt. I, pp. 3-84, 1893) and N. F. Drake (See Title No. 110, Rept. on the Colorado Coal Field of Texas, Fourth Ann. Rept. Geol. Surv. of Texas, pt. I, p. 423).

452. ROTHWELL, RICHARD P.

Art. Gold and Silver.

Report on Mineral Industries in the U. S., at the Eleventh Census, 1890.

ROTHWELL, RICHARD P.

(Gold and Silver Statistics—Texas), p. 93. Washington, 1893.

TEXAS.

COUNTIES.	Total amount of ore produced. (Short tons.)	Total amount of ore sold. (Short tons.)	Total amount of ore treated. (Short tons.)	Assay value of ore sold.		Total bullion value.			Estimated coining value produced from ore sold.	
				Gold.	Silver	Grand total bullion.	Gold.	Silver.	Gold.	Silver.
Total.....	12,996	1.355	10,441	$7,188	$86,968	$425,001	$6,828	$418,173	$6,828	$82,620
El Paso...........	2,355	1,355	....	$7,188	$86,968	$ 89,448	$6,828	$ 82,620	$6,828	$82,620
Presidio..........	10,641	....	10,411	....	....	335,553	....	335,553	....	....

See also table on page 59.

453. ———————, EDITOR.

Art. Asphaltum.

The Mineral Industry, Its Statistics, Technology and Trade, 1892, Vol. I.

(Asphaltum in Texas), pp. 35 and 36. N. Y., 1893.

"A deposit of bituminous limestone, said to be extensive, has been discovered in Western Texas, near the line of the Southern Pacific Railway, and a corporation, the Litho-Carbon Company, has been organized to work it. This material on refining gives a very good grade of asphaltum suitable for the manufacture of varnishes. Deposits of bituminous rock occur in the northern part of the State." P. 36.

454. ———————, EDITOR.

Art. Gold and Silver.

The Mineral Industry, etc., 1892, Vol. I.

(Gold and Silver in Texas), p. 189. N. Y., 1893.

From tables on page 189 the following statistics relating to the production of gold and silver are taken:

STATE.	1886.		1887.		1888.		1889.*		1890.		1891.	
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Texas.............	...	$ 200,000	...	$ 250,000	...	$ 300,000	$ 6,828	$ 418,173	...	$ 387,878	...	$ 484,848

*Statistics from the Eleventh Census.

455. ROTHWELL, RICHARD P., EDITOR.
Art. Gold and Silver.
The Mineral Industry, etc., 1893, Vol. II.
(Silver in Texas), p. 313. N. Y., 1894.

From a table on page 313 showing the production of gold and silver in the United States by States, the following statistics are taken:

(From the Mint Reports.)

STATE.	1890.		1891.		1892.*		1893.†	
	Gold vals.	Silver ozs.	Gold vals.	Silver ozs.	Gold vals.	Silver ozs.	Gold vals.	Silver ozs.
Texas	....	300,006	....	375,008	....	350,000	....	349,400

*The figures of the Director of the Mint for the production of silver in the United States for 1892 have been discredited, and consequently are not reproduced here. †The statistics of gold and silver production in 1893 was collected for this work, but we are indebted to the Director of the Mint for the approximate distribution by States, etc.

456. ——————, EDITOR.
Art. Asphaltum.
The Mineral Industry, etc., 1894, Vol. III.
(Asphaltum in Texas), p. 79. N. Y., 1895.

"The output from California was somewhat less than in 1893, but that from Utah increased slightly, and a very considerable increase came from the Texas deposits, though the Kentucky production was somewhat less. The asphaltic rock from Texas has increased in quantity, and has also a much higher average value than that of previous years."

The following statistics are taken from a table showing the "Production of Asphalt and Bituminous Rock in the United States":

(In Tons of 2,000 pounds.)

STATE.	1893.						1894.					
	Asphalt.			Bituminous Rock.			Asphalt.			Bituminous Rock.		
	Quantity.	Value.		Quantity.	Value.		Quantity.	Value.		Quantity.	Value.	
		Total.	Per ton.		Total.	Per ton.		Total.	Per ton.		Total.	Per ton.
Texas	....	....	....	1,000	$1,000	$1 00	....	....	....	7,200	$36,000	$5 00

457. ——————, EDITOR.
Art. Cement.
The Mineral Industry, etc., 1894, Vol. III.
(Production of Portland Cement in Texas), p. 92. N. Y., 1895.

ROTHWELL, RICHARD P.

From a table showing the production of Portland cement in the United States the following statistics are taken:

(In Barrels of 300 pounds.)

STATES.	1893 (a)			1894.		
	Barrels.	Value at works.		Barrels.	Value at works.	
		Total.	Per Bbl.		Total.	Per Bbl.
Texas	20,000	$ 40,000	$ 2 00	25,000	$ 50,000	$ 2 00

(a) Revised.

458. ———————. EDITOR.

Art. Gold and Silver.

Mineral Industry, etc., 1894, Vol. III.

(Production of Silver in Texas), p. 278. N. Y., 1895.

In a table showing the production of gold and silver in the United States by State, Texas is credited with 429,314 fine ounces of silver for 1894.

459. ———————, EDITOR.

Art. Gypsum.

The Mineral Industry, etc., 1894, Vol. III.

(Production of Gypsum in Texas), p. 355. N. Y. 1895.

From a table showing the production of gypsum in the United States the following statistics are taken:

(In Tons of 2,000 pounds.)

STATE.	1892.		1893.		1894.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
Texas	1,420	$ 8.520	1,815	$ 10,750	3,550	$ 21,300

460. ———————, EDITOR.

Art. Salt.

The Mineral Industry, etc., 1894, Vol. III.

(Production of Salt in Texas), p. 488. N. Y., 1895.

The following statistics are taken from a table showing the salt production in the United States:

ROTHWELL, RICHARD P.

(In Barrels of 280 pounds.)

STATE.	1893.					1894.				
	Evaporated.	Rock Salt.	Total bbls.	Value.		Evaporated.	Rock Salt.	Total bbls.	Value.	
				Total.	Per bbl.				Total.	Per Bbl.
Texas	144,435	.. ..	144,435	$115,548	$0.80	276,857	....	276,857	$230,000	$ 0.83

Compare with estimates given under Title No. 317.

461. ——————, EDITOR.

Art. Cement.

The Mineral Industry, etc., 1895, Vol. IV.

(Production of Portland Cement in Texas), p. 56. N. Y., 1896.

The following statistics are taken from a table showing the "Production of Portland Cement in the United States":

(In Barrels of 400 pounds.)

STATE.	1894.			1895.		
	Barrels.	Value at works.		Barrels.	Value at works.	
		Total.	Per Bbl.		Total.	Per Bbl.
Texas....................	18,750	$ 50,000	$ 2 67	15,000	$ 40 000	$ 2 67

462. ——————, EDITOR.

Art. Coal.

Mineral Industry, etc., 1895, Vol. IV.

(Production of Coal in Texas), pp. 125 and 126. N. Y., 1896.

The following statistics are from a table showing the "Total Production of Coal and Coke in the United States":

ROTHWELL, RICHARD P.

(In Tons of 2,000 pounds.)

STATE.	Coal.					
	1894.			1895.		
	Tons.	Value.		Tons.	Value.	
		Total.	Per ton.		Total.	Per ton.
Texas	469,904	$ 1,000,895	$ 2.13	499,668	$ 1,064,293	$ 2.13

The following is from a table showing the "United States Production of Coal, 1891-1895.

YEAR.	TEXAS.
1891	172,100 Short tons.
1892	300,000 "
1893	322,745 "
1894	469,904 "
1895	499,668 "

463. ——————, EDITOR.
Art. Gypsum.
The Mineral Industry, etc., 1895, Vol. IV.
(Production of Gypsum in Texas), p. 377. N. Y., 1896.

The following statistics are taken from a table showing the "Production of Gypsum in the United States":

(In Tons of 2,000 pounds.)

STATE.	1894.			1895.		
	Tons.	Value.		Tons.	Value.	
		Total.	Per ton.		Total.	Per ton.
Texas	3,605	$ 21,725	$ 6.03	5,670	$ 32,045	$ 5.56

464. ——————, EDITOR.
Art. Salt.
The Mineral Industry, etc., 1895, Vol. IV.
(Production of Salt in Texas), p. 550. N. Y., 1896.

The following statistics are taken from a table showing the "Salt Production in the United States:

ROTHWELL, RICHARD P.

(In Barrels of 280 pounds.)

STATE.	1895.		
	Evaporated.	Value.	
		Total.	Per barrel.
Texas	255,000	$ 211,560	$ 0.83

465. WEEKS, JOSEPH D.

Art. Petroleum.

Report on the Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Petroleum in Texas), p. 499. Washington, 1892.

The text and statistics for 1889 are the same as given in Mineral Resources of the United States for 1889-1890. See Title No. 416.

466. ————————

Art. Natural Gas.

Report on the Mineral Industries in the U. S., at the Eleventh Census, 1890.

(Natural Gas in Texas), p. 524. Washington, 1892.

Extract from table entitled "Capital Invested in the Natural Gas Industry in the United States in 1889":

STATES AND TERRITORIES.	Total capital.	Number of acres of natural gas land.			
		Total acreage.	Owned.	Leased.	Value.
Texas	$ 80,000	725	725	....	$ 72,500

INDEX.

I

S

Y

PROCEEDINGS

OF THE

TEXAS ACADEMY OF SCIENCE

FOR 1899.

THE TEXAS ACADEMY OF SCIENCE.

OFFICERS FOR 1898-1899.

PRESIDENT, THOMAS U. TAYLOR, M. C. E.
VICE PRESIDENT, H. H. HARRINGTON, M. S.
TREASURER, FREDERIC W. SIMONDS, Ph. D.
SECRETARY, WILLIAM L. BRAY, Ph. D.
LIBRARIAN, W. W. NORMAN, Ph. D.

Other Members of the Council.

H. L. HILGARTNER, M. D.
HENRY WINSTON HARPER, M. D., F. C. S.
GEORGE BRUCE HALSTED, Ph. D.

OFFICERS FOR 1899-1900.

PRESIDENT, FREDERIC W. SIMONDS, Ph. D.
VICE PRESIDENT, R. S. HYER, A. M.
SECRETARY, JAMES R. BAILEY, Ph. D.
TREASURER, R. A. THOMPSON, M. A.
LIBRARIAN, WILLIAM L. BRAY, Ph. D.

Other Members of the Council.

H. L. HILGARTNER, M. D.
HENRY WINSTON HARPER, M. D., F. C. S.
J. C. NAGLE, M. C. E.

PAPERS PRESENTED AT REGULAR MEETINGS.

FEBRUARY 3, 1899.

"Manual Training in Education," James E. Pearce, M. A., Principal of the Austin High School.

MAY 5, 1899.

"The Justice of the Court as Ideal Justice," Dr. S. E. Mezes, University of Texas.

"A Case of Spontaneous Combustion," Professor T. U. Taylor, University of Texas.

"Methods of River Flow and a Plan for a Hydrographic Survey of Texas," Professor T. U. Taylor, University of Texas.

JUNE 12, 1899—ANNUAL MEETING.

"Some Theorems in Geometry," W. H. Bruce, Ph. D., Athens, Texas.

"Southwestern Texas" (by title), William Kennedy, Austin.

"The Ecology and Embryology of the 'Rain Lilies,' " Felix E. Smith, Austin.

"An Annotated Record of the Geology of Texas for the Decade Ending December 31, 1896," Frederic W. Simonds, Ph. D., University of Texas.

"A Case of Fistula in the Neck of an Adult Man" (by title), W. W. Norman, Ph. D., University of Texas.

"The Behavior of Certain Caterpillars," W. W. Norman, Ph. D., University of Texas.

"Life Zones and Crop Zones in Texas" (by title), Dr. William L. Bray, University of Texas.

OCTOBER 6, 1899.

"From the Standpoint of a Man of Science," the Annual Address of the President, Dr. Frederic W. Simonds, University of Texas.

NOVEMBER 10, 1899.

"The Bachelor of Arts Degree," Professor W. S. Sutton, University of Texas.

DECEMBER 15, 1899.

"The Cretaceous of Obispo Cañon," E. T. Dumble, Houston.

"Occurrence of Oyster Shells in Volcanic Deposits in Sonora, Mexico," E. T. Dumble, Houston.

"The Modern Trend of Botanical Studies," William L. Bray, Ph. D., University of Texas.

"Some Recent Advances in Chemistry," Henry Winston Harper, M. D., University of Texas.

WESLEY WALKER NORMAN, PH. D.,

BORN, FEBRUARY 10, 1863.

DIED, JULY 1, 1899.

RESOLUTIONS ADOPTED OCTOBER 6, 1899.

WHEREAS, In the death of Dr. Wesley W. Norman the Texas Academy of Science has lost one of its most distinguished members and officers; therefore, be it

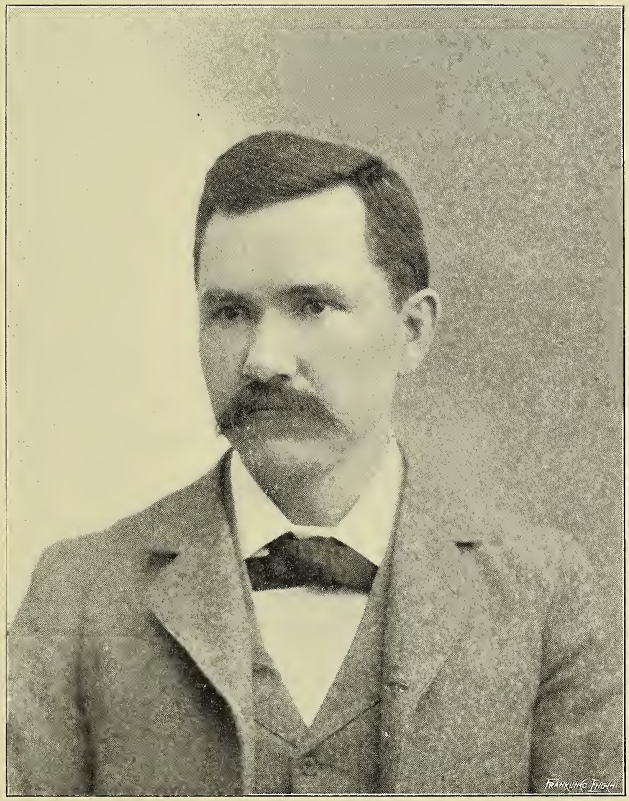
Resolved by the Executive Council of the Academy, That, as a faint expression of our esteem and reverence for him as a man, and our high estimation of him as a scientific worker, this testimonial and memorial of his worth be spread upon our records, presented to his bereaved family, and duly published.

The value of Dr. Norman's services to the Academy can not be measured by his contributions to its transactions, numerous and important as they may have been. As an organization the Academy should remember most gratefully his services, his wisdom in counsel, and his self-sacrificing labors as Secretary and Librarian.

In the Academy of Science, as in every other sphere of his influence, Dr. Norman's personal stimulus to his associates was of the highest order and efficacy; and his rare and noble personal force will be missed among us as that of few men could be.

(Signed)

H. L. HILGARTNER,
T. U. TAYLOR,
FREDERIC W. SIMONDS.



WESLEY WALKER NORMAN.

B. S. UNIVERSITY OF INDIANA, 1885; A. M. DE PAUW UNIVERSITY, 1894;
PH. D. UNIVERSITY OF CHICAGO, 1899.
ADJUNCT PROFESSOR OF BIOLOGY IN THE UNIVERSITY OF TEXAS, 1894 - 1896;
ASSOCIATE PROFESSOR OF BIOLOGY, 1896-1899.

BORN, FEBRUARY 10, 1863;
DIED, JULY 1, 1899.

COURTESY OF THE GULF FAUNA AND FLORA BULLETIN.

LIST OF PATRONS, FELLOWS AND MEMBERS.

PATRONS.

Brackenridge, George W., San Antonio, Texas.
Halsted, Mrs. George Bruce, Austin, Texas.

Patrons, 2.

FELLOWS.

Bailey, Dr. James R., Adjunct Professor of Chemistry, University of Texas, Austin, Texas.
Bray, Dr. Wm. L., Adjunct Professor of Botany, University of Texas, Austin, Texas.
Cerna, Dr. David, San Buenaventura, Coahuila, Mexico.
Charlton, Professor O. C., Baylor University, Waco, Texas.
Cline, Dr. I. C., Director of Weather Service, Galveston, Texas.
Clopton, Dr. A. G., University of Texas, Dept. of Medicine, Galveston, Texas.
Corner, Charles, Assoc. Inst. C. E., Umtali, Mashonaland, South Africa.
Curtis, George W., Weatherford, Texas.
Dickson, Dr. L. E., University of Chicago, Chicago, Ill.
Dumble, E. T., Geologist, 1708 Prairie Ave., Houston, Texas.
Dutton, C. E., Major, Ordnance Corps, U. S. A., Washington, D. C.
Ellis, Dr. A. Caswell, Adjunct Professor of Pedagogy, University of Texas, Austin, Texas.
Halley, R. B., Professor in Sam Houston Normal Institute, Huntsville, Texas.
Halsted, Dr. George Bruce, Professor of Mathematics, University of Texas, Austin, Texas.
Harper, Dr. Henry Winston, Professor of Chemistry, University of Texas, Austin, Texas.
Harrington, H. H., Professor of Chemistry, A. and M. College, College Station, Texas.
Herff, Dr. Ferdinand, San Antonio, Texas.
Hilgartner, Dr. H. L., Austin, Texas.
Hill, Robert T., Geologist, U. S. Geological Survey, Washington, D. C.
Howard, Wm. R., Professor in Fort Worth University, Fort Worth, Texas.
Hyer, R. S., Chancellor Southwestern University, Georgetown, Texas.
Keiler, Dr. Wm., University of Texas, Dept. of Medicine, Galveston, Texas.
Lefevre, Arthur, Principal High School, Victoria, Texas.
Macfarlane, Dr. Alexander, Chatham, Ontario, Canada.
McDaniel, Dr. A. C., 119 Alamo Plaza, San Antonio, Texas.
McRae, Dr. A. L., Oriel Bldg., St. Louis, Mo.
Mezes, Dr. S. E., Professor of Philosophy, University of Texas, Austin, Texas.
Montgomery, Dr. Edmund, Hempstead, Texas.
Mather, Dr. Wm. T., Professor of Physics, University of Texas, Austin, Texas.
Nagle, J. C., Professor of Civil Engineering in A. and M. College, College Station, Texas.

Northrup, Dr. E. T., 938 Market Street, Philadelphia, Pa.
Paine, Dr. J. F. Y., University of Texas, Dept. of Medicine, Galveston, Texas.
Pearce, James E., Principal of Austin High School, Austin, Texas.
Porter, Dr. M. B., Yale University, New Haven, Conn.
Punyear, Charles, Professor in A. and M. College, College Station, Texas.
Reichman, Fritz, Ryerson Physical Laboratory, University of Chicago, Chicago, Ill.
Schoch, E. P., Instructor in Chemistry, University of Texas, Austin, Texas.
Simonds, Dr. Frederic W., Professor of Geology, University of Texas, Austin, Texas.
Smith, Dr. Allen J., University of Texas, Dept. of Medicine, Galveston, Texas.
Smith, Dr. M. M., Austin, Texas.
Spence, D. W., Professor in A. and M. College, College Station, Texas.
Sutton, W. S., Professor of Pedagogy, University of Texas, Austin, Texas.
Taylor, T. U., Professor of Applied Mathematics, University of Texas, Austin, Texas.
Thompson, Dr. James E., University of Texas, Dept. of Medicine, Galveston, Texas.
Thompson, R. A., Engineer to Railroad Commission, Austin, Texas.
Townsend, C. H. Tyler, Professor A. and M. College, Las Cruces, New Mexico.
Wooten, Dr. Joe S., Austin, Texas.

Fellows, 47.

MEMBERS.

Askew, H. G., Auditor, Railroad Commission, Austin, Texas.
Banks, A. L., Professor in A. and M. College, College Station, Texas.
Battle, Wm. J., Professor of Greek, University of Texas, Austin, Texas.
Beall, Khleber H., Fort Worth, Texas.
Brooks, Sidney J., Attorney at Law, San Antonio, Texas.
Brown, Dr. B. S., Leona, Texas.
Brown, R. L., Attorney at Law, Austin, Texas.
Bruce, Dr. W. H., Athens, Texas.
Burgoon, C. E., Professor in A. and M. College, College Station, Texas.
Battle, W. W., Instructor in Baylor University, Waco, Texas.
Buck, Prof. L. L., Brownville, Texas.
Callaway, Dr. Morgan, Professor of English, University of Texas, Austin, Texas.
Capps, Dr. E. D., Fort Worth, Texas.
Carroll, J. J., Waco, Texas.
Carter, Dr. W. S., University of Texas, Dept. of Medicine, Galveston, Texas.
Chase, I. C., Professor in Fort Worth University, Fort Worth, Texas.
Cline, Dr. J. L., Galveston, Texas.
Cline, Dr. R. R. D., University of Texas, Dept. of Medicine, Galveston, Texas.
Connell, J. H., Professor in A. and M. College, College Station, Texas.
Cooke, Dr. H. P., University of Texas, Dept. of Medicine, Galveston, Texas.
Corner, Wm., San Antonio, Texas.
Crow, Dr. J. J., Waco, Texas.
Davidson, Dr. W. T., Surgeon U. S. A., Cuba.
Dohmen, Franz J., Soloman Strasse, 25a pt., Leipzig, Germany.
Duggan, Dr. Malone, Quarantine Inspector, Eagle Pass, Texas.
Duncan, A. Butler, P. O. Box 2891, New York City.
Endress, Geo. A., Southern Pacific Ry., Algiers, La.
Fitz-Hugh, Professor Thomas, Fredericksburg, Va.

Flavin, Dr. Thomas, University of Texas, Dept. of Medicine, Galveston, Texas.
Foster, L. L., President A. and M. College, College Station, Texas.
Freshney, Alfred, Teacher of Science, Austin High School, Austin, Texas.
Garrison, Dr. George P., Professor of History, University of Texas, Austin, Texas.
Garber, J. S., Houston High School, Houston, Texas.
Geisecke, F. E., Professor in A. and M. College, College Station, Texas.
Harper, Dr. W. A., Austin, Texas.
Head, A. B., Grandview, Texas.
Hill, L. E., Galveston, Texas.
Hogg, Alexander, Fort Worth, Texas.
Holmes, W. E., Austin, Texas.
Holzman, Clarence, Houston High School, Houston, Texas.
Houston, David F., Professor of Political Science, University of Texas, Austin, Texas.
Huberich, Chas. H., Austin, Texas.
Hundson, N. A., Teacher, Austin High School, Austin, Texas.
Hunnicutt, W. P. H., Land Office, Austin, Texas.
Hill, Dr. H. B., Austin, Texas.
Hopkins, Dr. J. W., Galveston, Texas.
Johnson, J. B., Professor in Baylor University, Waco, Texas.
Jones, W. G., Temple, Texas.
Kerr, E. W., Professor in A. and M. College, College Station, Texas.
Leitnaker, A. N., Vice-President Austin and Northwestern Railroad, Austin, Texas.
Liddell, M. H., East Orange, N. J.
Lomax, J. A., University of Texas, Austin, Texas.
Lewis, E. C.
McLaughlin, Dr. J. W., University of Texas, Dept. of Medicine, Galveston, Texas.
Mackensen, B., Teacher of Science, San Antonio High School, San Antonio, Texas.
Magers, S. D., University of Chicago, Chicago, Ill.
Magnenat, Dr. L. E., University of Texas, Dept. of Medicine, Galveston, Texas.
Mitchell, J. D., Victoria, Texas.
Moore, Dr. J. T., University of Texas, Dept. of Medicine, Galveston, Texas.
Malley, F. W., Professor in A. and M. College, College Station, Texas.
Ness, H., Professor in A. and M. College, College Station, Texas.
O'Connor, James L., Austin, Texas.
Phillips, John O., Austin, Texas.
Pittuck, B. C., A. and M. College, College Station, Texas.
Pessels, Dr. Constance, Teacher in San Antonio High School, San Antonio, Texas.
Poston, W. C., Professor in Weatherford College, Weatherford, Texas.
Primer, Dr. Sylvester, Professor of Romance Languages, University of Texas, Austin, Texas.
Putnam, T. M., Instructor in Mathematics, University of Texas, Austin, Texas.
Prather, Wm. L., President of the University of Texas, Austin, Texas.
Reber, Capt. Samuel, Signal Corps, U. S. A., Governor's Island, New York City.
Rice, C. D., Galveston, Texas.
Raines, C. W., Librarian, Dept. Insurance, Statistics, and History, Austin, Texas.
Sammonds, J. W., Palestine, Texas.
Schmidt, E. F., 508 Travis Street, Houston, Texas.

Schoch, Wm., Professor of Mathematics, Chicago Normal College, Chicago, Ill.
Seltzer, H. K., 658-659 Gibraltar Building, Kansas City, Mo.
Smith, Dr. H. S., Austin, Texas.
Smith, Dr. Q. C., Austin, Texas.
Smith, Noyes D., Austin, Texas.
Stanfield, S. W., Professor in Coronal Institute, San Marcos, Texas.
Stevenson, J. D., Attorney at Law, San Antonio, Texas.
Sublette, G. W., 2616 First Avenue, Minneapolis, Minn.
Swearingen, P. H., Attorney at Law, San Antonio, Texas.
Tilson, P. S., Professor in A. and M. College, College Station, Texas.
Underwood, P. H., Teacher, Ball High School, Galveston, Texas.
Warfield, Dr. Clarence, Galveston, Texas.
Williams, L. S., Professor of Chemistry, Armour Institute, Chicago, Ill.
Wilson, Dr. R. L., U. S. Marine Hospital, San Francisco, Cal.
Wyche, Benjamin, Librarian, University of Texas, Austin, Texas.
Worsham, Dr. B. W., Insane Asylum, Austin, Texas.
Wheeler, Dr. W. M., Professor of Zoölogy, University of Texas, Austin, Texas.
Zerr, G. B. M., Staunton, Va.

Members, 92.

Total Membership, 141.

LIST OF INSTITUTIONS WITH WHICH THE TEXAS ACADEMY OF SCIENCE EXCHANGES PUBLICATIONS.

AUSTRALIA.

Brisbane.—The Royal Society of Queensland.
Melbourne.—The Royal Society of Victoria.

AUSTRIA.

Wien.—Kaiserliche Academie der Wissenchaften.
Reichs Geologische Anstalt.

BELGIUM.

Bruxelles.—L'Académie Royale des Sciences, des Letters et des Beaux-Arts de Belgique.
Liege.—La Société Royale des Sciences de Liége.

BOHEMIA.

Prag.—Die Koenigl-boemische Gesellschaft der Wissenschaften.

BRAZIL.

Rio de Janeiro.—Museu Nacional de Rio de Janeiro.

CANADA.

Halifax.—The Nova Scotia Institute of Science.
Montreal.—The Natural History Society.
St. Johns.—The Natural History Society of New Brunswick.
Toronto.—The Canadian Institute.
University of Toronto.

ENGLAND.

Cambridge.—Cambridge Philosophical Society.
London—The Royal Geographical Society.
The Royal Society.
South London Entomological and Natural History Society.
Manchester.—The Manchester Literary and Philosophical Society.

FRANCE.

Marseille.—La Faculte des Sciences de Marseille.
Paris.—Museum d' Histoire Naturelle.

Toulouse.—L'Académie des Sciences, Inscriptions et Belles-lettres de Toulouse.

GERMANY.

Berlin.—Die Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte.
Giessen.—Oberhessische Gesellschaft für Natur-und Heilkunde.
Güstrow.—Verein der Freunde der Naturgeschichte in Mecklenburg.
Halle.—Naturforschende Gesellschaft zu Halle.
Kiel.—Der Naturwissenschaftliche Verein für Schleswig-Holstein.
Leipsig.—Die Naturforschende Geseschaft zu Leipzig.
Rostock.—Der Verein der Freunde der Naturgeschichte.

HOLLAND.

Harlem.—La Société Hollandaise des Sciences à Harlem.

HUNGARY.

Budapest.—Magyar Tudomànyos Akadémia.
L'Akadémie Hongroise des Sciences.
Die Akadémie der Wissenschaften.

IRELAND.

Belfast.—Natural History and Philosophical Society.
Dublin.—The Royal Dublin Society.

ITALY.

Livorno.—L'Associazione "Mathesis."
Palermo.—Circolo Matematico.
Pisa.—Societa Toscana di Scienze Naturali.
Torino.—Revue de Mathematiques.
Academia Reale delle Scienze.

JAPAN.

Tokyo.—Mathematical-Physical Society, Imperial University of Tokyo.
Zoölogical Society of Tokyo.

MEXICO.

Mexico.—La Sociedad Mexicana de Geografia y Estadistica.
Instituto Geologico de Mexico.
Observatorio Astronomico Nacional de Tacubaya.
Sociedad Cientifica "Antonio Alzate."

PORTUGAL.

Lisboa.—Real Observatorio de Lisboa.

RUSSIA.

Helsingfors.—Finska Vetenskaps-Societeten.
Kazan.—Société Physico-Mathématique de Kazan.
St. Petersburg.—L'Académie Impériale de Sciences.

SCOTLAND.

Edinburgh.—The Royal Society of Edinburgh.
Glasgow.—The Philosophical Society of Glasgow.

SOUTH AFRICA.

Cape Town.—The Philosophical Society of South Africa.

SWEDEN.

Gothenbourg.—Göteborgs Koengl-Vetenkaps och Vitterhets-Samhäles.
Stockholm.—Koengl-Vetenskaps Akademiens.
Upsala.—The Geological Institution of the University of Upsala.

SWITZERLAND.

Berne.—Die Naturforschende Gesellschaft.
Zurich.—Die Naturforschende Gesellschaft.

UNITED STATES.

Austin.—The Texas State Historical Association.
Baltimore.—Johns Hopkins University.
Johns Hopkins University Hospital.
Berkeley.—The University of California.
Boston.—The American Academy of Arts and Sciences.
The Boston Society of Natural History.
Buffalo.—Buffalo Society of Natural Sciences.
Chicago.—The Field Columbian Museum.
The Chicago Academy of Sciences.
The John Crerar Library.
Charlottsville.—The University of Virginia.
Cincinnati.—The Lloyd Library of Botany, Pharmacy and Materia Medica.
Colorado Springs.—The Colorado College Scientific Society.
Davenport.—The Davenport Academy of Science.
Denver.—The Colorado Scientific Society.
Des Moines.—The Iowa Academy of Science.
Denison Scientific Association, Granville, Ohio.
Indianapolis.—The Indiana Academy of Science.
Department of Geology and Natural Resources.

Jefferson City.—The Missouri State Geological Survey.
Knoxville.—The University of Tennessee.
Lawrence.—The Kansas University.
Lincoln.—The Nebraska Academy of Sciences.
Madison.—The University of Wisconsin.
The Wisconsin Academy of Sciences, Arts, and Letters.
Minneapolis.—The Geological and Natural History Survey of Minnesota.
The Minnesota Academy of Natural Sciences.
New York.—American Museum of Natural History.
New York Academy of Science.
New York Entomological Society.
Oberlin.—Oberlin University.
The Wilson Ornithological Chapter of the Agassiz Association.
Philadelphia.—The American Philosophical Society.
The Franklin Institute.
The University of Pennsylvania.
Portland.—The Portland Society of Natural History.
Rochester.—The Journal of Applied Microscopy.
The Rochester Academy of Science.
San Francisco.—The California Academy of Science.
St. Louis.—The St. Louis Academy of Science.
The Missouri Botanical Garden.
Topeka.—The Kansas Academy of Science.
Urbana.—Illinois State Laboratory.
Washington.—The U. S. Department of Agriculture.
Biological Society of Washington.
The U. S. Bureau of Education.
The U. S. Geological Survey.
The Smithsonian Institution.
The Southern History Association.
The U. S. Weather Bureau.
The Geological Society of Washington.

URUGUAY.

Montevideo.—Museo Nacional de Montevideo.