PROCEEDINGS

OF THE

Academy of Science and Letters

OF

SIOUX CITY, IOWA

FOR 1905-6

VOLUME II

PUBLISHED BY THE ACADEMY

SIOUX CITY, IOWA:
PERKINS BROS. CO., PRINTERS
1906

MRS. JENNIE T. CHARLES.

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VOLUME II

Committee on Publication:

F. H. GARVER H. C. POWERS, Editor E. E. STACEY

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INTRODUCTION

BY THE EDITOR.

Two years ago it was determined by the Sioux City Academy of Science and Letters to publish its first volume of proceedings with some of the papers which had been read at its meetings. But at once the question of finances became the important one. With a comparatively small membership and low dues our regular income did not much exceed our necessary current expenses. But as it was known that the Academy desired to publish its first book, financial help was offered us both by our members and friends, and the first volume was given to the public. Its reception by our local friends, and other scientific societies with whom we have exchanged, was very cordial, and we received many compliments from the press in all parts of the country. One of the comments most valued by the members of the Academy was that our work was so largely local. We have studied and written upon the subjects that were nearest to us; those that we were best acquainted with. In this, our second volume, we have endeavored to follow the same course, believing that every such society can do its best and most useful work on subjects in its own locality.

When the first volume was published, the members of the Academy hoped to be able to follow it up with succeeding numbers at intervals of two years. As with the first volume, the question of finances was the most important and hardest to be overcome, so it was with this, the second. But here again our way has been made smooth for us. A kind friend said to us: "Go ahead with the book and I will see to it that the money will be ready when it is needed." This kind friend is Mrs.

John H. Charles, who has been so long connected with the Academy and its predecessor, the Scientific Association. She, with her husband, Mr. John H. Charles, who finished his work and left us a little more than a year ago, has been a member of our association since its organization in 1885. Her interest, sympathy and help have been freely given to us through all the years of our existence.

The story of the long and useful life of Mr. Charles, as given in this volume, was told by him while he was here with us. The other articles in the book were written by members of the Academy, and most of them have been read at its meetings. We present them to the public in the hope that all may find something of interest and use among the various subjects discussed.

Sioux City, 1906.

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SECRETARY'S REPORT

To the Officers and Members of the Sioux City Academy of Science and Letters:

During the two years since the publication of the last volume of our proceedings twenty-two regular meetings have been held. On the following page will be found a list of the papers read and discussed at these meetings, which were, for the most part, well attended. The papers were, without exception, of a high order and well received.

At a special meeting held on August 6, 1906, the following resolution was passed:

"Resolved, That the offer of Mrs. Jennie T. Charles to furnish the money for publishing the Proceedings of the Academy be accepted, and the thanks of the Academy be extended to her; and that the donation be devoted only to the expense of the publication, which shall be limited to $200; and that the secretary notify Mrs. Charles of the action of the Academy."

At the same meeting the secretary reported that the Academy could secure rooms on the third floor of the City Building, and a motion prevailed authorizing the officers to move the museum from Morningside College to these quarters.

There have been a few changes in the membership. By the death of Mr. Charles and of Mr. Wakefield the Academy lost two of its staunchest supporters. Other enthusiastic workers have moved away; but the ranks have been filled with new members, and the work goes steadily forward.

On April 25, 1905, amendments to the By-Laws, Article II, Section 1, were adopted striking out the initiation fee of $1.00 and omitting "students of Morningside College" and "the Sioux City High School" as eligible to corresponding membership. The section provides that every member shall pay annual dues of $2.00 before the day prescribed for the annual meeting of each year, and that the dues of corresponding members shall be $1.00 per year, and that non-residents of Sioux City only shall be eligible to corresponding membership.

Respectfully submitted,

E. E. STACEY, Secretary.

Sioux City, Iowa, November 10, 1906.

PAPERS READ BEFORE THE ACADEMY.

1904-5.

Nov. 8, "Mounds in Northwestern Iowa," Hon. Geo. W. Wakefield.
Nov. 22, "What Is Evolution?" Prof. H. C. Powers.
Dec. 20, "Some Mental Phenomena," Prof. Willis Marshall.
Jan. 3, "Life History of a Flowering Plant," Prof. R. B. Wylie.
Jan. 17, "Indian Life on the Broken Kettle," Mr. W. T. Stafford.
Jan. 31, "Racial Incompatibility," Dr. G. J. Ross.
Feb. 14, "Economic Conditions and American Democracy," Prof. F. E. Haynes.
Feb. 28, "Some Defects in Our Municipal Government," Mr. E. J. Stason.
Mar. 14, "Bird Lovers' Innoculation," Mrs. Ida M. Casady.
Mar. 28, "The Social Crystal: A Parallel," Hon. J. H. Quick.
Apr. 11, "Reminiscences of Northwestern Iowa," Mr. C. R. Marks.

1905-6.

Oct. 31, "Further Investigation of the Indian Mound at Broken Kettle," Mr. W. T. Stafford.
Nov. 7, "History of the Formation of Iowa Counties," Prof. F. H. Garver.
Nov. 14, "Hypnotism: Its Influence with Relation to Our Commercial and Industrial Affairs," Mr. Louis Hirshberg.
Nov. 21, "The Relation of the Health Officer to the Public School,," Dr. Grant J. Ross.
Nov. 28, "Problems in Inebriety," Dr. J. E. Garver.
Dec. 5, "The Development of Agriculture by Drainage and Irrigation," Mr. J. S. McSparran.
Jan. 2, "The Conservative," Prof. F. E. Haynes.
Jan. 16, "The Present Status of the Science of Psychology: The New Vesus the Old," Prof. E. A. Brown.
Jan. 30, "Food Adulteration," Prof. W. Lee Lewis.
Feb. 13, "The Immortal Soul of My Dog," Prof. H. C. Powers.
Feb. 27, "The Lead and Zinc Deposits in the Upper Mississipp Valley," Prof. Ellwood C. Perisho.

TREASURER'S REPORT

RECEIPTS.

From April 19, 1904, to May 9, 1906.

Balance on hand	$ 28.66
Received from dues and subscriptions	273.57
Total	$302.23

EXPENDITURES.

Apr. 20, 1904—J. H. Charles, money advanced	$ 14.08
Apr. 20, 1904—H. C. Powers, hasps and locks	3.20
Aug. 10, 1904—A. N. Cook, express	2.75
Sep. 16, 1904—H. C. Powers, exhibit at Riverside and expense	10.75
Dec. 10, 1904—Circular letters	6.50
Dec. 13, 1904—Oscar Ruff	3.44
Dec. 14, 1904—Printing	10.00
Dec. 19, 1904—Weld Hardware Co.	3.00
Jan. 4, 1905—H. C. Powers, drayage	.75
Jan. 4, 1905—W. R. Montfort	3.00
Mch. 1, 1905—Fullerton Lumber Co.	7.33
Apr. 5, 1905—Perkins Bros. Co.	130.00
Apr. 25, 1905—F. H. Garver, expense	1.75
June 12, 1905—Perkins Bros. Co.	50.00
Jan. 27, 1906—Printing	8.00
Mch. 13, 1906—Postage	2.00
Mch. 13, 1906—Typewriting	1.00
Mch. 13, 1906—Printing	10.35
Apr. 5, 1906—W. T. Stafford	14.50
Apr. 5, 1906—Printing	4.25
May 9, 1906—Perkins Bros. Co.	15.58
Total	$302.23

LIBRARIAN'S REPORT

BOOKS AND PAMPHLETS RECEIVED DURING BIENNIAL PERIOD ENDING APRIL 3, 1906.

BOARD OF CONTROL, STATE OF IOWA—

Quarterly Bulletins—Volume VI. Nos. 1, 2, 3, 4.
Quarterly Bulletins— " VII. Nos. 1, 2, 3, 4.
Quorterly Bulletins— " VIII. Nos. 1, 2.

BOARD OF WATERWORKS TRUSTEES, SIOUX CITY, IOWA—

Annual Reports, 1st, 2nd, 3rd, 6th.
Rules and Regulations for Use of Patrons.

BUREAU OF EDUCATION, U. S.—

Report of U. S. Commissioner of Education for Year 1903, Volumes I and II.

CIVIL SERVICE COMMISSION, U. S.—

Annual Reports—20th, 1902-3.
Annual Reports—21st, 1903-4.
Annual Reports—22nd, 1904-5.

CITY CLERK, SIOUX CITY, IOWA—

Municipal Directory, 1905-6, 1906-7.

CHARLES, JOHN H.—

Constitution and By-Laws of the Davenport Academy of Science, 1889.
The Relation of the Sexes from a Scientific Standpoint.
On the Structure of the Skull in the Plesiosaurian Reptiles and on Two New Species from the Upper Cretaceous, by E. D. Cope, 1894.
Kirmiss.

COOK, A. N.—

Transactions of the Wisconsin Academy of Science, Arts and Letters. Volume XII, Part I, 1898.

DAVENPORT ACADEMY OF SCIENCES—

Proceedings, Volume IX, 1901-3.

DEPARTMENT OF COMMERCE AND LABOR, U. S.—

Annual Reports—
- 15th, 1900—Wages in Commercial Countries (2 vols.)
- 16th, 1901—Strikes and Lockouts.
- 17th, 1902—Trade and Technical Education.
- 18th, 1903—Cost of Living and Retail Prices of Food.
- 19th, 1904—Wages and Hours of Labor.
- 20th, 1905—Convict Labor.

Bulletins—Nos. 1-64.
Monthly Consular and Trade Reports—
- No. 298, July, 1905.
- No. 299, August, 1905.

FITZPATRICK, T. J.—

Manual of the Flowering Plants of Iowa, by T. J. Fitzpatrick.
Part I, Polypetalae.
" II, Gamopetalae.

FRYE, T. C.—

The Embryo Sac of Casnarina Stricta by T. C. Frye.

GARVER, F. H.—

Iowa Journal of History and Politics—
Vol. I, Nos. 1, 3, 4.
" II, " 1, 2.
Iowa Educational Directory, 1898-9, 1902-3, 1903-4, 1905-6.
Report First and Second Iowa State Conferences of Charities and Correction, 1898 and 1899.
Complete Education, by D. S. Wright.
Report of Second Annual Meeting of the Iowa State Bar Association.
A Plea For Peace—An address by Yearly Meeting of Friends, Phil.
Program of Fiftieth Annual Session of the Iowa State Teachers' Association, 1904.

GEOLOGICAL SURVEY, IOWA STATE—

Twelfth Annual Report, Vol. XIV, 1903.
Thirteenth Annual Report, Vol. XV, 1904.
Supplementary Report, Part II, 1903 (Grasses of Iowa).

GEOLOGICAL SURVEY, U. S.—

Bulletin No. 257, 1904.
Bulletin No. 260, 1904.
Professional Paper, No. 32, 1905.—Preliminary report on the Geology and Underground Water Resources of the Great Central Plains, by N. H. Darton.
Water Supply and Irrigation Papers.—Nos. 32, 33, 40, 43, 45, 46, 53, 55.

GEOLOGICO INSTITUTO DE MEXICO—

Parergones, Tomo I, Numeros 2, 3, 4, 5, 6, 7, 8.

HISTORICAL SOCIETY OF IOWA, STATE—

The Iowa Journal of History and Politics.
Volume II—No. 4.
" III—Nos. 1, 2, 3, 4.
" IV—Nos. 1, 2.

MESSAGES AND PROCLAMATIONS OF THE GOVERNORS OF IOWA—

Volumes I, II, III, IV—1903.
" V, VI—1904.
" VII—1905.

HISTORICAL DEPARTMENT OF IOWA, STATE—

Annals of Iowa—

Volume VI—Nos. 5, 6, 7, 8.

" VII—Nos. 1, 2, 3, 4, 5, 6.

Early Settlement and Growth of Western Iowa by Rev. John Todd.

HORTICULTURAL SOCIETY, IOWA STATE—

Transactions—Volume 34, 1899.

" — " 40, 1905.

HUBBARD, HON. E. H.—

Census of Philippine Islands, 1903 (4 vols.)

Iowa Journal of History and Politics—

Volume II—No. 4.

" III—Nos. 1, 2.

Iowa Official Register, 1901, 1903 (4 copies.)

Collier's Self-Indexing Annual, 1905.

Regulation of Railroad Rates. Argument of J. H. Call before Committee of U. S. Senate on Interstate Commerce.

Some Legal Aspects of Railroad Rate Making by Congress, by Richard Olney.

The Federal Courts and the Orders of the Interstate Commerce Commission, by H. T. Newcomb.

Bureau of American Ethnology—

Bulletin 28—Mexican Antiquities.

" 29—Haida Texts and Myths.

U. S. Department of Agriculture, Bureau of Statistics—

Bulletin 35—Imports of Farm and Forest Products, 1902-4.

" 36—Exports of Farm and Forest Products, 1902-4.

U. S. Department of Navy—

Astronomical Papers, Vol. VIII, Part III, Catalogue of Zodiacal Stars for 1900-1920.

U. S. National Museum—

Bulletins—No. 53 (Part I), Catalogue of Fossil Invertebrates.

Bulletins—No. 54, Isopods of North America.

" —No. 55, Oceanography of the Pacific.

Special Bulletins—Oceanic Ichthyological (2 vols.).

Smithsonian Institution Annual Report, 1904.

INTERSTATE COMMERCE COMMISSION—

Annual Reports—

15th, 1901.

16th, 1902.

17th, 1903.

18th, 1904.

19th, 1905.

IOWA ACADEMY OF SCIENCES—

Proceedings for 1903, Vol. XI.

Proceedings for 1904, Vol. XII.

LIBRARY OF CONGRESS—

Select List of Recent Purchases in Science, 1904.
Want List of the Publications of Foreign Societies, 1904.
Want List of Prediodicals and Serials (Domestic), 1904.
Classification Q, Science, 1905.

M'DOWELL, M. F.—

Circular Dichroism in Natural Rotary Solutions, by M. F. McDowell.

NATIONAL ACADEMY OF SCIENCES—

Memoirs—
Volume I—1865.
" II—1883.
" III—1886, Part 2.
" IV—1888, Part 2.
" VI—1893.
" VII—1895.
" IX—1905.

NATIONAL MUSEUM, U. S.—

Proceedings—
Volume 20—
" 21—
" 22—
" 23—1901.
" 24—1902.
" 25—1903.
" 26—1903.
" 27—1904.
" 28—1905.
" 29—1906.
" 30—1906.

Reports—
1886—Part II of Smithsonian Report.
1888—
1897—Part II of Smithsonian Report.
1898—
1899—
1903—
1904—

Bulletins—
No. 53—Part I, Catalogue of Fossil Invertebrates.
No. 54—The Isopods of North America.
No. 55—The Oceanography of the Pacific.

Special Bulletins—
American Hydroids, by Nutting—
Part 1—The Plumularidae.
Oceanic II—The Sertularidae.
" Ichthyology (2 vols.)

PINCKNEY, J. M.—

Northwestern Pomology, by C. W. Gurney.

SECRETARY OF STATE, IOWA—

Executive Documents for 1904 (vols. 1-8.)
Iowa Official Directory, 1905.

SMITHSONIAN INSTITUTION—

Contributions from U. S. National Herbarium—
Volume VIII, Part 4—Studies of Mexican Plants.
" X, Part 1—North America Species of Festuca.
Reprints from the Proceedings of the U. S. National Museum. One hundred and fifty-three separate papers ranging from No. 900 to 1205.

SUPERINTENDENT OF PUBLIC INSTRUCTION, IOWA—

Biennial Reports, 1899, 1901, 1903.
Handbook for Iowa Schools, 1906.
Advance Sheets of Biennial Report, 1904.

SWEETLAND, E. E.—

Eight Hundred Common Words.

WAKEFIELD, GEO. W.—

Report of Smithsonian Institution, 1889, 1891.
Bulletin Iowa State Board of Control—
Volume III—Nos. 1, 2, 3, 4.
" IV—Nos. 1, 2, 3, 4.
" V—Nos. 1, 2, 3, 4.

WEBSTER, CLEMENT C.—

Contributions to the Paleontology of the Iowa Devonian, by C. C. Webster.
Preliminary Observations on Some of the Constituent Elements of the Glacial Drift of Northern Iowa, by C. C. Webster.
Observations on the Pottery Made by the Ancient and Modern Aborigines of the Southwest, by C. C. Webster.
The Old Land of the Sioux, by C. C. Webster.

WISCONSIN SOCIETY OF ARTS, SCIENCES AND LETTERS—

Transactions—
Volume XIV—Part II, 1903.
" XV—Part I, 1904.

WYLIE, R. B.—

The Biological Laboratories of Morningside College, by R. B. Wylie.

SUMMARY.

IN LIBRARY AT LAST REPORT, APRIL 19, 1904—

Paper volumes	15	
Bound volumes	112	
Total		127
Pamphlets		95

ACCESSIONS DURING BIENNIAL PERIOD ENDING APRIL 3, '06—

Paper volumes	43—	
Bound volumes	74	
Total		117
Pamphlets		321

NOW IN LIBRARY—

Number of volumes	244
Number of pamphlets	416

CONTRIBUTIONS DESIRED.

1. Files of newspapers, magazines, catalogues, etc., especially those published in the Northwest.
2. Old letters, manuscripts, diaries, journals and biographies of old settlers and others.
3. Data concerning the naming of cities, towns, townships, lakes and rivers of the Northwest.
4. Facts of Indian history, manners, customs, stories or legends.
5. Minutes of religious bodies, conventions, conferences, synods, etc.
6 Catalogues of Iowa, Dakota and Nebraska educational institutions.
7. Publications of scientific and of historical societies.
8. Books, papers, pamphlets or other publications of Sioux City authors.
9. Old directories of Sioux City.
10. Reports of Sioux City officials.
11. Journals of the General Assemblies of Iowa.
12. Statute laws of Iowa.
13. Code of Iowa.
14. Reports of the Pioneer Lawmakers' Association of Iowa.
15. In brief anything that relates to the history of Iowa or of the West, the preservation of which will have value in the future.

To complete files already begun the following are solicited:

1. U. S. Geological Survey for years 1885-6, 1887,8 and 1889-90, Part I.
2. Iowa Geological Survey, vols. 5, 7, 8 and 9.
3. U. S. Ethnological Reports.
4. Interstate Commerce Commission Reports, vols. 1-14.
5. Civil Service Commission Reports, vols. 1-19.
6. Proceedings of U. S. National Museum, vols. 1-19.
7. Proceedings of Davenport Academy of Science, vols. 1-7.
8. Transactions of Wisconsin Academy of Science, vols. 1-11.
9. Proceedings of Iowa Academy of Science, vol. 1.
10. Annals of Iowa, vols. 1-5, and vol. 6. Nos. 1-4.
11. Iowa Executive Documents prior to 1904.

Sioux City, Iowa, April, 1906.

F. H. GARVER,
Librarian.

OUR COLLECTION.

BY THE CURATOR.

Whenever a group of persons of congenial minds join themselves together for the purpose of study and mutual benefit in any line of scientific investigation, a collection of specimens illustrating their chosen field of work is very sure to be begun. Members of the association will bring any curious or doubtful specimens they may have or find to the meetings to be shown and talked over, and so the beginning of a collection will be made. As a pearl grows from its small nucleus by continued accretions from without, so has our collection grown from its first single specimen brought to a meeting of the old Sioux City Association back in the year of its beginning, 1885, until now, when we have a large lot of specimens, thousands in number. They came to us singly and in small numbers as well as in larger collections, given by friends who had gathered them together in their travels in many lands. Our thanks are especially due for generous gifts of specimens from Mrs. Florence Charles Martin of Minneapolis, Mrs. Caroline Groninger Gore, Mrs. T. J. Stone, Mrs. Mary Booge and Mrs. J. M. Davis, all of whom have given us valuable collections of fine material. To the many other friends from whom our specimens have come our thanks are heartily given. In trying to tell you something of our collection I shall avoid, as far as possible, the long and hard names given to natural history specimens by scientists, describing some of them so that all can understand what they are and where they came from. Many individuals in collecting, only look for one kind of specimens, such as old coins, shells or Indian relics, while our collection covers many different branches of natural science.

First let us look over this case of mineral ones. These are the minerals most sought after by mankind all over the world. Here are specimens of gold, silver, copper, tin, iron, lead and zinc, brought together from all over our country and Europe. These gold ores are from many of our noted mines in the western states and from Alaska. Not many of them show the pure gold, while most of them appear like ordinary bits of rock such as we might find almost anywhere. This small nugget of pure gold came from the Yukon River in Alaska. From the celebrated Homestake Mine came this piece of gray rock, showing no traces of gold, but rich ore still. Some of the least promising in appearance have the largest percentage of gold. There just beside the gold ores seem to be pieces of common gray rock, but are quite heavy. They are silver ores, some of them very rich in the metal. This one, for its size, is very heavy. In every pound of this ore there is more than a half pound of pure silver, but not many mines produce such valuable ores. Next in the same case are specimens of copper ores from the rich mines of Michigan and Montana. The specimens from the Michigan mines on Lake Superior are almost all pure metallic copper. It seems strange to think that copper ore can be so pure as not to be worth mining, but some such ores are found in the Michigan mines. Masses of pure copper weighing many tons are found there, and the labor in cutting such a mass into pieces small enough to be taken out of the mines and smelted costs as much or more than the pig copper is worth. These specimens of pure copper from those mines have all sorts of fantastic shapes. The rocky matrix from which these pieces came seems to have been shattered and broken millions of years ago, and afterwards every crack and crevice was filled with pure metallic copper. Where did it come from, and how was it deposited in these strange shapes we have here, are questions we all might ask. We may, perhaps, find our answers in the copper mines of Montana. There the water that is pumped from the mines holds so much copper in solution that pure metal stalactites are being formed wherever the water trickles down from rock or timber. If you dissolve copper sulphate (blue vitriol) in water and then place any metallic object in the solution it will be at once coated with pure copper. Some time in the long ago, water holding copper in solution was forced up through the broken rocks of northern Michigan and deposited its load of metal, filling every crack and crevice. In this manner were probably made the wonderfully rich deposits of that region. The ores from the Montana and Arizona mines, while very rich in copper, are not pure metal as are these from Michigan.

Not many years ago it was thought that tin ores rich enough in metal to pay for mining could not be found in our country, and nearly all the tin we used was brought from Europe or the East Indies. But rich mines of this metal have since been discovered in our western states, and are being worked. These specimens of tin ore do not have any appearance of the pure shining metal that is so common everywhere. Here in the same case are lead ores from many parts of our country. Galena or lead ore was discovered and mined in Wisconsin and Iowa by the first white men coming there. It is a very heavy metal and the ore has a bright and shining surface where broken. It is found in two common forms, massive and in cubical crystals. The lead ore of Wisconsin, Illinois and Iowa is generally in the form of cubes, although much of it is massive or uncrystalized. Nearly related to the lead is the metal zinc, which is generally found in the same regions as the lead ores. Here is a fine specimen of very pure zinc ore from Joplin, Missouri. Sixty-five per cent. of this piece is pure metal. And here is another specimen from the same mines that is called by the miners, dry bone. It is more porous and less heavy than the first one and does not yield so large a percentage of zinc. And now let us look over these ores of our most valuable metal. We could more easily do without all of those I have before spoken of than we could without the more common iron. Iron is our most useful metal, in its various forms of cast iron, wrought iron and steel. Iron ore is found in vast quantities in the United States and in most other countries. Its most common form is called hematite. Then there is limonite, or bog iron ore, magnetite ore, a natural magnet. Here is a specimen of "spiegeleisen" brought from Prussia because of its richness in carbon. It is extensively used in the manufacture of Bessemer steel. All are familiar with the appearance of the metal mercury or quicksilver. Here is the ore from which it is obtained. It is called Cinnabar, and came from California. From these most useful minerals to the more common ones we call rocks is only a step. Our collection contains many varieties of these. Granite, sandstone, limestone, diorite or hornblende are a few of the names we know them by. All our building and paving stones belong to this class of minerals. The volcanic rocks we have in a fine lot of specimens, such as lava, obsidian or volcanic glass, pumice, etc. From the Sandwich Islands came this specimen, which looks like gray hair from some animal. The natives called it Pele's hair from one of their gods. It is blown out of the Volcano Kilauea, on the island of Hawaii, and is a form of obsidian.

From the wonderful petrified forest of Arizona we have a large lot of specimens of the wood of long ago, in their many beautiful shades of color, all changed to stone. Many other specimens of petrified wood are here from other localities. In another case are a large lot of crystalized minerals, the most common of which are quartz, or silica, and lime. All minerals are found at times in these crystalized forms. From the Hot Springs region of Arkansas, the Black Hills of Dakota and the Yellowstone National Park they have come to us by the hands of our friends. Here are beautiful clusters of limpid quartz crystals, with other crystals of colored silica, such as amethysts, smoky quartz and garnets. Geodoes of quartz, rough on the outside but lined with beautiful crystals. Then the many forms of lime crystals in clusters, geodes and single ones are shown in our cases. Gypsum or sulphate of lime from which our cement and plaster of paris are made is here both in crystals and in massive form. Beautiful forms of chalcedony we have in numbers. Large and fine specimens of mica from the mines of North Carolina and our western states is shown. Rock salt from Germany and Wyoming is here.

The most beautiful of our minerals are the agates banded in their various colors. When polished, as the large number of our collection is, they are very beautiful. So many colors blended together in bands of differing shades and thickness, and they are only the common quartz with iron, manganese or other minerals mixed, which produce such different colors and shadings. There are many other species of minerals in our cases which I have not spoken of.

Thus far I have spoken almost entirely of the inorganic forms of mineral, that is, those that have never been a part of living animal or vegetable beings. Without vegetable life we should miss nearly all our great beds of iron ore, as iron held in solution in water is only rendered insoluble and thrown down as sediment near decaying vegetation. Our specimens of petrified wood were once parts of trees growing where we find them in Arizona today. Our great quarries of even-bedded limestone are entirely the remains of animal life, such as worn out shells, corals and bones of fishes or animals. It is true there are many comparatively small deposits of limestone in all parts of the earth made by the lime deposits of hot springs and the dripping of water in caves, and these are not organic. But the great mass of limestone is entirely made of the remains of animal life.

Of fossils, the remains of the animal life of the past, while our collection contains a large number, we still need many additions, especially those of the older formations. We have a few from the Palaeozoic age, but need many more. From the Hamilton period of the Upper Geodes of quartz, rough on the outside but lined with large addition from these earlier forms of life would be especially welcome. As we come up towards the later geological formations, the Cretaceous, Tertiary and recent periods, we have some very fine and unique specimens. Our northwest part of Iowa, where not covered by the glacial clay or loess, is nearly all Cretaceous, from which we have many fine fossils. From the clay of this period, which is used in the numerous brick yards in this region, many fine specimens have been found. In the fall of 1887, workmen were digging a cistern on a farm several miles north of Sioux City. When down about six feet below the surface in the hard blue clay of the Cretaceous period they came upon some fossil bones. Fortunately the owner of the farm, Mr. D. H. Talbot, was sent for at once, and being an enthusiastic student of science the find was carefully taken out and all parts preserved. It proved to be the remains of a large saurian or reptile, something like the alligators still living in the waters of our southern states. During the Cretaceous period the huge reptiles, which became so numerous in the succeeding Tertiary age, began to make their appearance, and these fossil bones were the remains of one of them. It was an animal with a body as large as that of an ox, having a long flexible neck, while its head was not larger than that of a medium sized dog. It was a flesh-eating animal, its mouth being filled with sharp, conical teeth. This one, the remains of which we have, was not far from twenty feet long, as we know from the number of vertebrae found, which was eighty-one. It had four legs or swimming paddles, short and massive. These remains were sent to the eminent scientist, O. C. Marsh of Yale College, who pronounced the animal to have been, in all probability, a Plesiosaurus. These reptiles lived in the salt marshes bordering the great ocean that at that time covered the interior of our continent. It is probably a new species and has been named Plesiosaurus Hoskinsi from our esteemed fellow member, Mr. J. C. C. Hoskins, who helped preserve the fossil remains, and who first described it when found. This is one of our most valuable specimens.

The chambered nautilus is one of the most beautiful sea shells now living. Back a hundred million years in time the first fossil shells of this family are found. These first ones from the Trenton period of the Lower Silurian had plain smooth partitions between the chambers, but as time went on these septa or partitions became folded in more complex shapes until, in the Ammonites of Cretaceous times, they were folded in the most complex convolutions. We have many specimens of such fossils in different genera and species. The Ammonites were coiled flat like the Nautilus, and were from an inch to three feet in diameter. Turritellites had an open coil rising to a point in the center, while the Baculites were straight, chambered shells. These are all represented in our collections. Trees such as we now have first grew in abundance during the Cretaceous period. Their leaves are preserved in the rocks of that time, and we have many specimens of them.

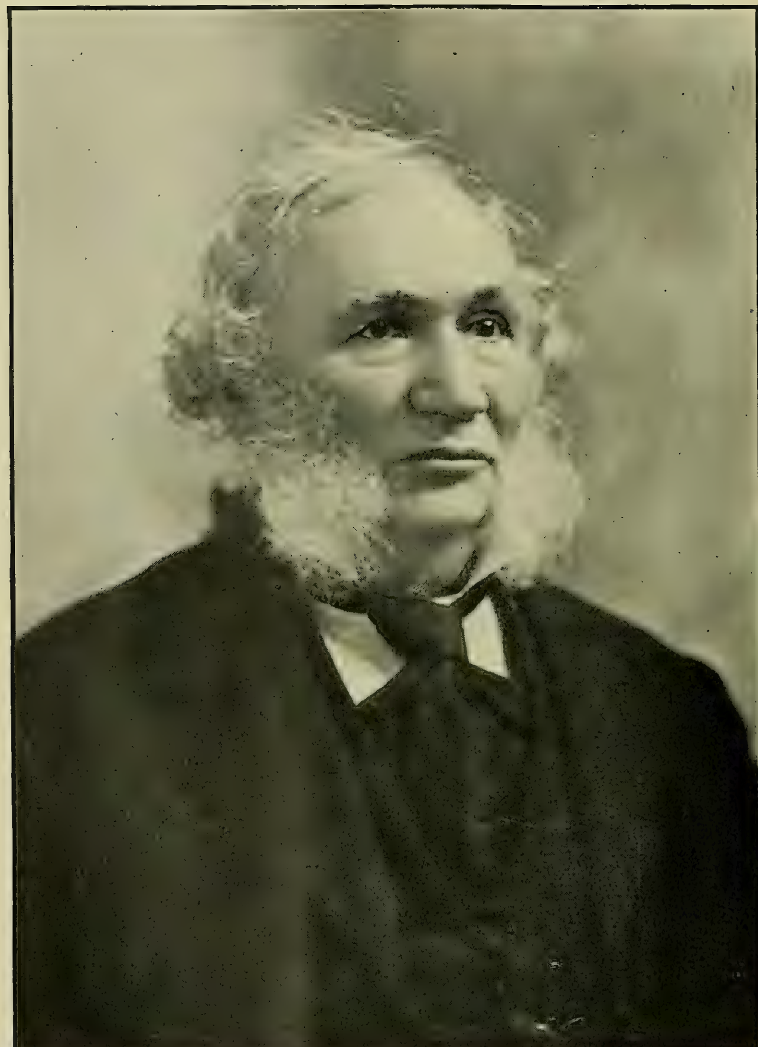
Coming down to more recent times, the yesterday of geology, this part of our country had wild elephants living here. Their remains are frequently found from Alaska to Florida. We have a lot of the bones of these monsters in our collection. They were not just like our living elephants, but resembled them in form. They were frequently much larger, and the one, the remains of which we have, was not less than ten or eleven feet in height. These bones, for they are so recent that they are still bones and not petrifactions, were found in Nebraska. One of the leg bones which we have is four feet and eight inches in length. The vertebrae are eight inches in diameter and four inches in thickness. The ball and socket ones of the hip joint are eight inches in diameter, while those of an adult man are only about one and one-quarter inches in diameter, thus showing the immense difference in bulk between man and the mammoth.

When the white men first came to this part of our country they found it peopled with a warlike nation of Indians called the Sioux. But long before then there had been another Indian people called Mandans, who had occupied this region for a long time. The Indian mounds, which are so numerous all over the northwest part of our state, were probably constructed by these Mandans or even an earlier race of Indians. These mounds are full of broken pottery, flint, bone and shell implements. From a large mound near our city thousands of such specimens of Indian work have been taken, and many more thousands are yet buried there. Our collection contains many of these relics of a people who long ago disappeared from this part of the country. We have also a cast from the largest stone ax ever found in the U. S. Its dimensions are fourteen inches in length, eight inches in width and three and one-half inches in thickness. The weight of the original is 31 pounds. This original was on exhibition at the world's fair at St. Louis and is now in the collection of the State University at Iowa City. Our cases also contain many specimens of the work of the natives of the Sandwich Islands.

Of recent specimens, the most beautiful and varied in shape and color are probably the sea shells and corals. Of these we have a fine lot from all over the world.

And now, after having very briefly described a small part of what we have in our collection, our wants in this direction may be spoken of. We have just moved the whole collection from Morningside College, where we have had it for the last two years, down to the Library Building, where we have been given quarters. The room we have, while much too small for the proper exhibition of our museum material, is much better than the one we had before. Our great need is, first, for a larger and better lighted room. Then more floor cases can be made, which are very much needed, as those we have are crowded so full as to prevent proper labelling of specimens. We would gladly receive and preserve all kinds of specimens illustrating natural history, archeology, ethnology, paleontology or mineralogy. We also desire very much life size protraits of old settlers of this city and vicinity. With increased room and small financial help we could easily build up a museum that would be worthy of the pride of all our citizens.

Perhaps many will ask what use we can make of this collection, what it is good for, etc. Now such questions as these are entirely reasonable and I am glad to answer them before they are asked. First, the use of all we have is freely offered to the public. Our room will be open to visitors at least two afternoons in each week, when all who may come will be welcomed and shown what we have. The Curator will be present and will gladly show and explain, as far as he is able, all of our collection. Then arrangements will be made for the pupils of our public schools to visit and study any part of this collection. We hope to make this part of our work of value to our young citizens in their school work. In short, all we have will be for the free use of the public who will always be most cordially welcomed by those in charge of this collection.



JOHN H. CHARLES.

REMINISCENCES OF JOHN H. CHARLES.

INTRODUCTION.

By F. H. GARVER.

The first plat of Sioux City was made in 1854. The late Mr. John H. Charles came to the new town on December 1, 1856, remaining here till the day of his death, which occurred on December 1, 1904, the forty-eighth anniversary of his coming. He was not a pioneer only; his residence in Sioux City had spanned at the time of his death practically the whole history of the town. He was here when the population numbered but a few hundred; he saw it increase to 40,000. He was here when the community possessed but little wealth; he saw prosperity come and abide. He was here when manners were rough and the country was wild; he saw culture come and refinement.

Mr. Charles' life was primarily a business career. He was sucessively a real estate dealer, surveyor, clerk, merchant and government transportation contractor. Though not a politician, and never an office seeker, he was yet called upon to serve the community in the various capacities of justice of the peace, alderman and Mayor. Other honors could have been his for the asking, but he had a distaste for public office, and rejected all suggestions of personal preferment. He chose to give his spare time and surplus energies to interests of a semi-private character. In this field several different subjects and enterprises claimed his attention and received his support. For years he was a loyal member of the Sioux City Scientific Association. He served the association as its president from 1892 to 1903. In the latter year he was foremost in the organization of the Academy of Science and Letters which was formed to succeed the Scientific Association. During its first year Mr. Charles was president of the Academy. At the time of his death he was President Emeritus. For more than a mere pastime he brought together from many places a numerous and valuable collection of geological specimens and Indian relics.

Mr. Charles was much interested in the Sioux City Public Library. To it he gave many books and much of his time serving as a trustee from the establishment of the library to his death. Personally he was a great reader. His private library was one of the largest and best appointed in the city. It also contained many rare volumes of great age and value, another example of his collecting spirit.

As a pioneer, who for fifty years had witnessed the remarkable changes brought by advancing civilization, Mr. Charles was anxious that the story of the early history of Sioux City and of Iowa be preserved. A close friend of Mr. Charles Aldrich, Curator of the State Historical Department, he possessed a deep sympathy for the work of that institution and backed up his interest in a substantial manner. He was also for several years before his death a member of the State Historical Society of Iowa.

The chief service of Mr. Charles to the cause of local history was in connection with the erection of the Floyd monument. He was one of the organizers, in 1895, of the Floyd Memorial Association, an organization formed for the purpose of commemorating, in some suitable way, the name of Sergeant Charles Floyd, a member of the Lewis and Clark expedition, who died on the upward journey, in 1804, and was interred upon a bluff within the present limits of Sioux City. From 1896 on until his death Mr. Charles was president of this association, which in 1900-1 crowned its years of labor with brilliant success by erecting over the grave of Floyd a stately shaft one hundred feet in height. This successful consummation of the association's work, though many devoted men and women contributed to it, was more the work of Mr. John H. Charles than of any other individual. This fact is recognized by the Floyd Memorial Association itself, since at a recent meeting it voted to place upon the Floyd monument a bronze tablet in appreciation of the services of Mr. Charles in the erection of the same.

It was Mr. Charles' desire to aid in the preservation of the early history of Sioux City that caused him to dictate to the editor, during the late summer of 1904, the following reminiscences. In doing this no especial system was followed. Mr. Charles talked as the inspiration came, choosing his own subjects to some of which he would return on later days and make additions. The first task of the editor was to write out the dictations and read them to Mr. Charles for his correction. Such occasions were often seized by him for still further additions. One result of this method was to produce a fragmentary effect. The narrative was not always consecutive.

The chief task of the editor has been to rewrite and rearrange the Reminiscences, to verify statements and to correct what errors had crept in. Mr. Charles' exact words and phrases have been retained wherever possible. No facts have been altered. The meaning has always been preserved. One has a right to private views, hence no changes of mere opinion have been made.

Mr. Charles was asked to spell all personal names as he dictated. His spelling has been preserved in the text. Sometimes it was that of the frontier which, though common then, would not always pass now. Where a different spelling has been suggested by the editor it has been placed in brackets in the text. Sometimes initials and given names have been missing. Whenever it has been possible to supply these they also have been placed in brackets. Other minor corrections have been indicated in the same way.

Footnotes have been added by the editor for two reasons: partly for the purpose of making corrections more important or more extensive than those mentioned above; partly with the view of adding more light to the subject in hand.

The headings have all been inserted as an aid to the reader.

What follows is not an autobiography of Mr. Charles. He makes no attempt here to tell the complete story of his life. A brief sketch of his career appears in Volume I of the Proceedings, the data for the same having been furnished by him at another time. Here Mr. Charles has limited his remarks mostly to life in Sioux City prior to 1865. His remarks are largely local and personal. The latter part, in which he recalls and describes a dozen prominent characters of early days, was added at the suggestion of the editor.

It is hoped that this paper may contain something of interest and value to the future historian of this locality. Any errors still found in it will be eagerly caught up and corrected by surviving pioneers; at least such corrections are invited. Perhaps others will be thus led to write down their own experiences, a result much to be desired.

The editor is under obligations to Mrs. John H. Charles for many favors. Also to Mr. J. C. C. Hoskins and Mr. George Weare for kindly going over the articles with him in search of errors, and to Mrs. Mary E. Hagy for verification of several points.

ANCESTRY AND YOUTH.

My ancestors, on my father's side, were Swiss. My great-great-grandfather's name was Henry, or rather Heinrich, Karli. He was a native of the canton of Zurich, Switzerland. In 1734 he emigrated to America and settled in Manor Township, Lancaster County, Pennsylvania. He was the father of three sons, namely: Joseph, John and Jacob. Joseph had two sons named John and Joseph. John, the eldest of these, was my grandfather. He also had two sons named respectively Joseph and John. Joseph was my father. He spelled his last name Charles, the family name having been Anglicized since their immigration to America.

I was born in Lancaster County, Pennsylvania, on January the 19th, 1826. My mother's maiden name was Elizabeth Kauffman. Her people, who were also Swiss, had come to America and settled in Pennsylvania in 1717. I was the oldest child in a family of six children, four boys and two girls. In May, 1826, when I was four months old, my father moved from Pennsylvania to Mifflin Township, Richmond County, Ohio. A little later a shifting of county boundary lines threw my father's farm into Ashland County. This farm is still in the family. One of my sisters, Mrs. Ben J. Urban,[1] now lives upon it [1904]. It is located about nine miles east of the city of Mansfield, Ohio.

I lived on this farm until I was twenty-four years of age. The first fifteen years were uneventful. At fifteen I began to learn the trade of a carpenter and joiner, at which I worked most of the time during the summer months until I was twenty-four. For four or five winters I taught school. For this employment I received during the first year eleven dollars a month and "boarded around." When I quit teaching I was receiving twenty dollars a month, the highest wages paid in Ashland County at that time.

FIRST TRIP TO CALIFORNIA.

In the spring of 1850 the news of the discovery of gold in California reached our place. I, as well as many others, caught the "gold fever." Being a strong young man, and in my prime, I soon made up my mind to go. My folks were not much in favor of my plan. They, however, made no objection to my departure, though they saw me go with great anxiety. It was on the 13th day of March, 1850, that I left the old home for the far West. I went by rail from Mansfield, in an adjoining county, to Sandusky City, where I stopped over night. Next day I went by rail to Cincinnati, where I took passage on the Yorktown, a large steamer commanded by Captain Haldeman, for St. Louis. The trip down the Ohio and up the Mississippi rivers took us ten days. While in St. Louis I stopped at the Missouri Hotel, which a gentleman who was waiting for passengers on the levee said was the "cheapest dollar a day house in the town."

I left St. Louis on the steamer El Paso and went up the Missouri river as far as Liberty Landing,[2] from which

1. Mrs. Urban died October 12th, 1906, after this article had gone to the printers.

2. In western Missouri, just south of the town of Liberty and a little east of Kansas City.

place emigrants started at that time for California. At Independence, Missouri, we "fitted out" for California, which was the "far West" then surely. We bought four yoke of oxen for each wagon, loading each with about two thousand pounds of provisions, outfit, etc. This was not a large load for such a team, but we thought it safest to have enough oxen. There were about eighty persons in our crowd. Altogether we had twenty-one wagons, which with their four-yoke teams made a very formidable appearance. We had not gone far, however, before grass became scarce. Then, too, we could not always agree as to the best route to be taken. For these reasons our large party soon split up into smaller ones, each taking whichever route it pleased.

By the middle of May we reached Grand Island, Nebraska, where we found our first good grass. This was an important item, since our cattle were already getting weak and thin. From Grand Island, where we struck the valley, we moved up the Platte river to old Fort Carney [Kearney], thence west by Ash Hollow and the North Platte to Fort Laramie, situated at the point where the Laramie fork enters the North Platte. Arrived at the Rocky Mountains, we did not follow the Union Pacific track over the divide, though this was the usual route, but took rather the South Pass over the mountains, which were passed about June 1. Once over the Great Divide we went down the Humboldt[1] River to the Carson river and then up the Carson river to its head. The journey across the Sierra Nevada range, which was reached early in August, brought the greatest suffering of the whole trip, for the snow was heavy and it was biting cold. The crust on the snow was strong enough to bear up our heavy wagons, for which we were thankful, since it lessened the hardship somewhat. Descending the western slope of the Sierra Nevada range we reached the gold fields at a place called Hangtown [now Placerville], California, about September 1.

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1. In Nevada. No effort has been made to identify the exact route taken on this journey because the story of this trip may be considered as merely introductory to the main narrative to follow.

The three greatest trials of our four months' journey had been in crossing the Sierra Nevada mountains, some difficulty in always finding grass for the cattle, and scarcity of water, which was felt at times. It was in Nevada that we suffered most for water. On one occasion we ran out and while I stayed to guard camp my colleagues made a detour of many miles on either side in search of water. While I was awaiting the return of my friends a man came across the sands bearing a small keg of water upon his shoulder. When he came to camp I asked for a drink and was informed that I could have a cup of water for one dollar. I was so thirsty that I paid for the drink. Before leaving the man asked if we had an abundance of food. I answered "Yes." He started away, but soon came back and asked for something to eat. I charged him a dollar for a square meal and so got even with him.

I soon tired of prospecting for gold, and went to work for a mining company. The miners almost coerced newcomers into working for them, they wanted men so badly. Wages were high, so by May of the next year I had saved one thousand dollars. We had sold our surplus provisions upon arrival for a good price. Not liking life in the mining region, I now decided to return to Ohio, making the homeward journey by way of the Isthmus of Panama.

SECOND TRIP TO CALIFORNIA.

I now remained at home for eighteen months. Upon my arrival there I was sure I should never go West again. But soon several young men in my county began to plan a trip to California and I joined them. We went again to Independence, Missouri, for our start across the plains. Here three of us who had made the trip to California before bought up a hundred cows. We got them for less than twenty dollars per head. We had an idea that we could drive them to California and make some money on them. We followed about the same route which I had taken two years before. We reached the mining country in the spring of 1853 and had no trouble in selling our cows at eighty dollars per head.

Our party tried prospecting near Sacramento City. After a time I gave that up and superintended the construction of a plank road leading out of Sacramento City. During the spring and summer of 1855 I farmed. In December of the same year I started East again, this time by way of Nicaragua, reaching Ohio in February, 1856. I remained at home until fall.

COMES TO SIOUX CITY.

During the summer of 1856, while in Lancaster, Pennsylvania, on a visit, I learned that the United States government had made some rich land grants to three railroads[1] that were going to build across the state of Iowa. Several things turned my attention westward again. First, I had been West twice and got something of the Western spirit. I had an uncle who was loaning money on Wisconsin lands and he talked about the West to me. Then the nomination of Buchanan for president that summer seemed to promise trouble with the South, and finally I thought the land in Iowa would make a good investment. So I made up my mind to go West and settle down for good. After a careful study of the maps I chose Sioux City as my destination and started. From Mansfield I came by rail via Chicago to Iowa City.[2] Thence I went by stage to Des Moines, where I stopped off a few days. A second stage brought me to Fort Dodge. The hardest part of the journey lay between that point and Sioux City. No regular stage ran between these two places, only a lumber wagon which carried mail. In this I took passage. It took us six days to make the trip. The first night we spent at Twin Lakes, the next at Sac City, and the third at Ida Grove, where I stopped with a friend, Judge [J. H.] Moorehead. The last three nights we spent at Mapleton, Smithland and Sergeant's Bluff respectively. At the latter place I passed the night with Mr. [W. P.] Holman. We finally reached Sioux City on Monday morning, December 1, 1856, dur-

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1. These three railroads grew into the present Rock Island, Chicago and Northwestern, and Illinois Central systems.

2. This was as far west as the railroad came in Iowa in 1856.

ing a fierce snow-storm. That night I stopped at the Hagy House, or Western[1] Hotel, of which John Hagy was proprietor. The hotel was located on the levee at the corner of Second and Water streets. It consisted of two log cabins near together, the space between enclosed only with rough hewn boards. The house was ordinarily referred to as "The Terrific."[1]

A dozen men were in the hotel lobby. All were in shirt sleeves, but each man wore from two to four flannel shirts. One old man named Cowan, known familiarly as "Colonel," sat by the stove with an umbrella raised over him. The storm was very severe and blew so much snow into the upper part of the room that it settled down all over the floor. Above the stove the heat changed the falling flakes into rain, hence the umbrella. The men were a hard-looking set, harder than I had seen in the California mines or even on the Isthmus. They were dirty and ragged, but talked chiefly of their real estate sales and of the money they had made. But they looked harder than they were, for some of them were well educated and have since made their mark.

Near bed time I looked around for a sleeping room. Seeing none, and wishing to make inquiry, I approached the only man in the hotel whom I saw wearing a white shirt. He answered that none of the men had rooms, that there were no rooms, and that I would be lucky to get even a bed. He said that he himself slept between the two houses, and not having any bed fellow I could sleep with him. He probably noticed that I also wore a white shirt, and since we two were the only guests that did, this may be the reason why he took me in preference to any one else. We soon retired to sleep, under a buffalo robe. That is all that kept us from freezing. In the morning we were covered with snow several inches deep. Frost had formed around our eyes and mouths and our faces were covered with snow and ice.[2]

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1. The Hagy House of 1856 was called the Northwestern House later. The nickname "Terrific" had been applied to the house before Mr. Hagy became proprietor.

2. Mr. Charles' bedfellow that night was Charles K. Smith, afterwards postmaster of Sioux City.

When we arose in the morning we found the kitchen snowed up. The cook stove was completely covered. The dining room was half full of snow and it was still storming; indeed, it continued storming all that day and the next. It was nothing less than a genuine northwestern blizzard of wind and snow. On the whole, coming as I did almost direct from California, where running water never freezes, I thought I had been given a rather cold reception in Sioux City.

Since the kitchen was snowed under, our hotel could not serve breakfast. About 8:30 a. m. I started out to get a bite to eat. The storm had not abated and I found the streets almost impassable. But I was successful in that I finally succeeded in getting what was called a "hot breakfast" at the Sioux City House, located on Pearl street between Fifth and Sixth.[1]

While going in search of this meal I met at the postoffice[2] Mr. Samuel T. Davis, whom I looked upon as a friend as soon as I learned that he was from Pennsylvania, the state in which I was born. The severeness of the storm caused some of those who went through it to give up their half-formed intentions of locating here, but after talking with Mr. Davis about Pennsylvania, California and some other states we made up our minds to stay in Sioux City. In closing the conversation I said to him, "I'll be in Sioux City on the morning of January 1, 1900, and as the sun rises over the hills to the East I'll say, 'Hail, old Fellow! I'm still here.'" It came to pass. On the morning of January 1, 1900, Mr. Davis took breakfast with me at my house. Forty-four years had passed since we first met that stormy day in the little postoffice. You can guess what we talked about.

LOCATES A TOWNSITE.

After looking around to see what could be done I made up my mind that I must pay expenses during the winter. So I went across the river, took up a claim in Nebraska and went to cutting cord wood and saw logs. In this way I made enough extra money to buy a com-

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1. Rather on the corner of Fifth and Pearl. Building is still standing.

2. Located on the corner of Second and Pearl streets.

pass in the spring so I could take up surveying, an occupation much to my liking. I soon had a chance to use my compass. During the last days of February, 1857, a man from Ohio, named Bennett, came to Sioux City. He represented an Ohio company which desired to locate a townsite somewhere along the Missouri river above here. None of this country had been surveyed and townsites had to be located as best they could in order to be held against the settlers. The pre-emption law allowed this to be done providing certain conditions were met. Mr. Bennett engaged me to locate his townsite for him. Accordingly on March 1, 1857, I took my compass and started, together with Father Martin of Dakota City, from Covington,[1] where my claim was, for the upper river. We had a span of horses and a sled to haul the provisions. The claim-men, ax-men, etc., walked, I with the rest. Towards evening of the first day we got as far as St. Johns,[2] Nebraska, where John Tracey [3] lived. The snow was two feet deep and we could make but slow progress. On the second day the expedition reached Ponca, where we stayed over night. The next day we started for Concord,[4] which is at the head of Lime Creek. When we got there we found some Sioux City people—S. B. Mullhollen (Mullholland) and [Wesley S.] Trescott among them. The fourth night we camped on the open prairie and almost froze to death, as it was the night of a terrible blizzard. It was only by building a big fire that we managed to live through it.

Next night we stopped at St. James,[5] Nebr., on the Missouri River, where we found trappers who had gone there to trade with the Indians. I made my bed on a

1. Located on the Nebraska side of the Missouri opposite Sioux City. Both town and claim have since been washed away.

2. Town has disappeared and site has been washed away. The present town of Jackson (Dakota County, Nebraska) is said to represent the former town of St. Johns.

3. A Catholic priest and founder of St. Johns, having led a colony of Irish Catholics there in 1856. The fiftieth anniversary of this event was celebrated at Jackson during the summer of 1906.

4. There is a town named Concord in Dixon County, Nebraska, but it is too far south to be the town here indicated because the party was following the Missouri river closely.

5. In Cedar County.

pile of beaver skins and was sleeping away, like a pig under a gate, when, sometime during the night, I was awakened by loud talking and swearing on the part of the trappers. They had remained up late to play cards and got into some dispute about the fairness of the game. They were so abusive that I thought some one would be killed, especially since their revolvers were much in evidence, yet no harm came of it. These four men were Bill Copeland, John [Henry] Campbell, Bill Craven[s] and [John] Mitchell, commonly called "Old Mitch."

Next morning we went up the river to a point opposite the present site of Yankton, S. Dak., where we found a party of New York men holding a townsite. On the way we had passed a high rocky point, which had looked so good to me and commanded such a fine view that I now recommended that we return to it. This recommendation suited Mr. Bennett, so we went back and staked out a townsite consisting of over 2,000 acres, or more than three sections. This took us nearly a week, after which we were ready to return to Sioux City. In the meantime the snow had melted and the return trip was not so difficult. After reaching home I platted the town, naming it Opechee, a name afterward changed to St. Helena. It was in Cedar County, Nebr., opposite[1] the present village of Gayville [which is in Yankton County, S. D.]. Bennett went east and had the plat lithographed and sold lots right and left, getting himself into trouble,[2] since the land had not yet been surveyed by the United States government.

FATE OF THE FOUR TRAPPERS.

In the fall of 1857 I was elected a Justice of the Peace in and for Woodbury County. One of the first cases to come before me was the trial of a man named Wm. O. Allen, for killing Bill Craven[s], one of the quarreling trappers whom we had met at St. James. Allen was bound over to the District Court, and, since there was no jail any nearer, the Sheriff[3] started off with the prisoner to Council Bluffs. They got as far as the

1. The town is still in existence.
2. And into the penitentiary.
3. John Braden.

Floyd River, then the Sheriff came back and reported that the prisoner had broken away. One thing is certain, he never came back.

Previous to our leaving St. James, the four trappers had had a second quarrel. "Old Mitch" was killed[1] by a blow on the head, "decently" buried in a shoe box, and nothing was ever done about it.

During the spring elections of 1858, Bill Copeland had a quarrel with H. W. Tracey, in front of the latter's store on lower Pearl Street. As a result Tracey shot him. This was the third violent death among these four men inside of a year. But such things were not uncommon on the frontier in those early days. The survivor, John [Henry] Campbell, soon went east "for his health," and what became of him I do not know. I had had enough interest in these men to keep track of them as far as stated.

Because of the escape of Allen and the miscarriage of justice in other cases I became so disgusted with the office of Justice of the Peace that I would have nothing more to do with it. But before leaving the subject altogether I might mention another of my exploits as Justice.

PERFORMS FIRST MARIAGE CEREMONY.

One day while I was putting up an office opposite the Sioux City House, on Pearl Street, a man drove up and asked if I was Mr. Charles. I replied that I was. Then he asked if I was a Justice of the Peace. Again I gave him an affirmative answer. He said I was wanted at the Pacific Hotel, down on Fourth Street, where there was a small settlement.

I got into his rig and went with him, expecting that I was wanted to make acknowledgment of a deed. Reaching the hotel I was led to the parlor, and there introduced to a Miss Livermore and a Mr. [Osmond] Plato, who, I was informed, desired me to marry them. I wouldn't have been more surprised if they had told me I was to be shot. Up to that time my experience with weddings had been very slight; I had seen just one, my

1. By Henry Campbell, mentioned in the following paragraph.

sister's. What to do I did not know. Just then the man who had come after me handed me a paper and said: "This is their license." I took the license and looked it over, pretending to read, but, in reality, I was trying to make up my mind what to say. Having made it up, I asked the parties to stand up and join hands. Then I asked if there were any objections to the union of the couple. There being none, I said, "By virtue of the authority vested in me as a Justice of the Peace I pronounce you man and wife," and it was all over and just as well done as if it had been performed according to the elaborate Episcopalian ring service.

PERFORMS MARRIAGE CEREMONY IN DAKOTA TERRITORY.

On the first day of January, 1858, there came to my office in Sioux City a company of half-breeds and Indians from across the Big Sioux, who wanted me to come over there and marry a Frenchman and a Crow squaw.

While I was first a Justice the title "Squire" became attached to may name. After I had thrown up the office, following the escape of Allen, the murderer of Craven[s], I was still "Squire." Some years later I was appointed Justice by J. P. Allison, County Judge, to fill out an unexpired term. But when asked to go over to Dakota Territory[1] to marry this couple I was not a Justice at all, and so had no authority to perform such ceremonies. Even if I had been a Justice, my jurisdiction would not have extended outside of Woodbury County, much less outside of the State. So, of course, I refused to go.

The company went down town and saw Mr. L. H. Kennerly, who sent them back to me with instructions to go over and marry the couple. By and by Mr. Kennerly, himself, came up and talked with me. He said the Indians wanted me very badly and honestly believed that I could legally perform the ceremony. I repeated the statement that I had no authority, but finally, after Mr. Kennerly had presented the matter at length, I arranged for an escort of some twenty men and promised to go.

1. This phrase is allowable, though Dakota Territory was not established till March 2, 1861.

In truth, I was afraid of the half-breeds and didn't want to go. I know now that it was not a serious matter, but I thought differently then.

Next day we crossed the river. Arriving at the hut where the ceremony was to be performed we found everything in readiness. Without much delay I had the couple stand up. The Frenchman could not understand a word of English nor the Squaw a word of either French or English. The Squaw had insisted that an American perform the ceremony. She had been deceived upon a former occasion and now would trust only an American.

After the ceremony I asked a Mr. [Enos] Stutsman, who was present, a one-legged man,[1] but talkative, to make an address. This he did, giving the newly married couple some good advice, which they could not understand, and wishing all present a good time and finally that all might go to the Happy Hunting Grounds and have a continual good time there.

The next thing on the program was the feast to be given at another house down on the bank of the Missouri River. To this place we proceeded through the brush and timber, each fellow for himself. Even the bride and groom had to travel in this way. Arriving at the house we found ample provision had been made for the feast. Great camp kettles full of bouillon (soup of dog) made up the principal dish. Of this all were invited to partake. Nearly all present did, but for some reason I had no appetite. Then I was given a piece of beaver tail, considered by the Indians a great delicacy. This was considered as an honor for me, for, since I had performed the marriage ceremony, I was looked upon by the Indians as a great chief, and treated as one—at very little expense to themselves.

After we had sat down to the feast some one asked where the bride and groom were. We all looked around but they were certainly not present. Upon investigation we found them outside. We at once made room for them and brought them in so that they too might partake of their own wedding feast. Coffee and hardtack were now served, so I did not go hungry, in spite of the bouillon.

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1. A cripple from birth. Both legs were deformed and almost missing.

After supper we all went back to the Angie cabin, where the marriage ceremony had been performed. Here a certain John Brazo [Brazeau] played the fiddle and the dance proceeded, as was customary upon such occasions. Brazo was a character who was accustomed to say that he was the first "white man" in this part of the country. In fact, if he was not a negro, for he was as black as one, or a mulatto, he was at least a very dark Spaniard. In my opinion he had both negro and Indian blood in his veins, but that made no difference with him. He considered himself a white man, and, as far as he was concerned, that settled it. After the dance our party returned to Sioux City. This was the first wedding in Dakota Territory after white settlers came to Sioux City.

Whatever became of the married couple I do not know. I presume, however, that the Frenchman learned the Indian language, since the French did this readily, and perhaps became a fur trader. Of the twenty white persons who accompanied me across the river to perform that marriage ceremony but two or three are left to tell the story [1904]. One still living is James E. Booge, of Sioux City, and another is "Gov." F. M. Ziebach, of Yankton, S. Dak.

SETTLEMENT OF SIOUX CITY.

In 1857 there were two clusters of houses in Sioux City, one on the levee on Second Street and the other in the region of Sixth and Douglas. At the latter place were located the U. S. land offices for the receiving and registration of claims, as well as the offices of many private land agents.

The first settler in Sioux City, probably, was Joseph Lyonais [Leonais] or Theophile Brughier [Bruguier].

Dr. John K. Cook, government surveyor, laid out the first city and named the streets. It consisted of a half section, laid out into lots, on the west side of Perry Creek. This was in 1854.

Then Sioux City East was laid out on the east side of Perry Creek, followed by a half section up on the bluffs known as Chamberlain quarter.

The population in 1857 numbered less than one thousand, though it was larger in this year than at any subsequent date till 1865, the last year of the war. Of the population, anywhere from two-thirds to three-fourths were transients, many of whom were frightened away by the hard times following the panic of 1857 and by Indian scares during the war. The population came largely to make money out of the sale of Northwestern Iowa lands. One-fourth of the state was for sale at the Sioux City land offices.

The inhabitants came from all parts of the U. S., but in largest numbers from Virginia, Kentucky, Indiana and Illinois. Pennsylvania and Ohio were not so numerously represented.[1] I was called a Pennsylvanian because I was born there, but, as I had lived most of my life in Ohio, I was more truly an Ohioan.

Everything needed in a frontier town came up the river by steamboat from St. Louis or Council Bluffs. The regular mail came in this way.

I remember I came into Sioux City from Ft. Dodge in an open wagon, called a stage by courtesy, which carried mail. This was one of the first overland mails to come to Sioux City.

During my first year of residence in Sioux City [1857] a number of boats ran regularly in the Sioux City trade. Coming up from St. Louis about once a month they brought us almost everything. I remember especially the Omaha, Captain Wineland, as being one of the most regular.

The American Fur Company's boats for the upper river made but one trip a year, it was so long and perilous. Going up in the spring, loaded with merchandise, they did not return till fall, full of valuable furs. These boats all stopped at Sioux City both going and coming.

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1. A study by the editor of the nativity of seventy of the old settlers of Woodbury County showed that the largest number was born in New York. Other states ranked in the following order: Vermont, Ohio, Pennsylvania, Illinois, Indiana, etc. These old settlers did not all come to Woodbury County directly from the states of their birth. The states from which most of them came were in this order: Illinois, New York, Ohio, Wisconsin, Indiana and Pennsylvania.

EARLY CITY POLITICS.

The year before I came to Sioux City there occurred a three-cornered contest[1] for the County Seat between Sioux City, Smithland and Sergeant's Bluff. Sioux City outvoted the others, and got the prize.

The election was held near the corner of Sixth and Douglas streets at the United States land office.[2] Out in the street in front of the office there was a well. A barrel of whisky was brought, placed beside the well and tapped. Whisky was as free as water that day, and as easily obtained.

The first election after I came to Sioux City took place in Aug., 1857. It was the charter election, i. e., the election when a city charter was voted on. The charter carried unanimously. I was one of the judges of the election, and as Kirkie [Cartier], "the wild Frenchman," came up to vote someone challenged his vote on the ground that he was not a citizen of the United States, but he swore that he was. I administered the oath to him, closing with the words, "So help you God," whereupon he exclaimed, "I hope so, too, for no one else ever helped old Kirkie [Cartier].

A number of votes were sworn in in this way, among them that of Joe Leonais and others who had been fur traders for the American Fur Company. We did not know whether they were legally citizens or not, but it was safe to have them swear in their votes.

At these early elections we voted everybody. Everyone who could swear in his vote did so. Half-breeds were generally challenged, but since they were always willing to swear in their votes they were allowed to cast them.

There were three wards in Sioux City at this time [Aug., 1857]. Two aldermen were chosen from each ward. I was chosen an alderman from the Second Ward. My colleague was Enos Stutsman. Since the city government was not organized at this time, as will be explained, we never served the city in the capacity of councilmen.

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1. This county seat election was held on April 7, 1856.

2. Incorrect. The election was held at Thompsontown or Floyd's Bluff. The incident following, though it probably did not apply to this election, was more or less typical of early elections here.

The candidates for mayor at this election had been Ezra Millard[1] and Captain J. B. S. Todd, both democrats. Millard received the largest number of votes, but because of some irregularity the votes of one ward were thrown out and Todd was declared elected. Not satisfied with such proceedings Todd refused to serve, leaving the town without any municipal organization until the following spring.

Again [Apr., 1858] two democratic candidates were pitted against each other. They were Dr. Townsend and Col. [Robt.] Means. The later was elected, and served as mayor one year.[2] Col. Means was quite a character. Immediately before retiring each night he always blacked his boots and brushed his hat. The first thing he did upon rising in the morning was to brush his hat and black his boots. Questioned why he did this he would reply, "I black my boots twice so that I may always have a shine left after the top one wears off."

PERSONAL POLITICS.

In 1857 Sioux City was a land office town. The two United States senators from Iowa were Geo. W. Jones and A. C. Dodge, both democrats. The democratic party was so strong here that there were not enough republicans to maintain an organization. But the democrats were divided into two factions, called the "Hards" and the "Softs," and this gave the republicans a chance. There were many regular fire-eaters here at that time and elections were generally disorderly.

I remember that when, in 1857, we voted upon the new state constitution I voted to strike out the word "white" and this offended many of my friends. But it was a matter of principle with me. I could not agree in all things with the dominant party. If I had been entitled to a vote in 1856 I should have cast it for Fremont and Dayton. But I had left California too late and had not attained a residence here before election day. I had lost my vote in 1852 in much the same way. In 1848 I cast my first ballot voting for Van Buren and Adams, the third party candidates.

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1. A brother of United States Senator Joseph H. Millard, of Nebraska.

2. It was at this election that Tracey shot and killed Copeland.

BANQUET AT TREMONT HOUSE.

I well remember Thanksgiving Day of 1857 because of a dinner which I attended at the Tremont house, a new hotel built in central Sioux City. Mrs. Hagy kept the hotel. I was made chairman of the evening because I came from the president's state. On my right sat J. P. Allison; on my left H. W. Tracey. Some of the others present were: L. C. Sanborn, Jerome R. White, J. B. Flagg, Al Lovering, Chas. Warren, Col. Means and L. H. Kennerly. All are dead now [1904] except Kennerly, Allison and myself; perhaps Kennerly is, but he was not a year or two ago.[1]

This dinner I have good reason to remember vividly. We had a great old time. Mr. White and I were the only men present who did not drink. We were the only sober ones in the crowd, and sometimes I suspected White.

Each one had to sing a song or tell a story. Some of the boys got up onto the table and walked back and forth over it. You will find this dinner reported in the Sioux City Weekly Eagle, Vol. I.[1]

The Sioux City Eagle was the first paper published here. It was edited by Seth W. Swiggett, who died a few years ago in Chicago. In politics the Eagle was neutral with democratic leanings. Its first issue was put out on July 4th, 1857. About two years later it was superceded by the Sioux City Register, "Gov." F. M. Ziebach, editor.

SIOUX CITY AS A LAND OFFICE TOWN.

As I said before, Sioux City was, in the early days, a land office town. The U. S. Government Land Office, where claims were received and recorded, was situated here, as well as many private real estate agents.

Land sold generally at $1.25 per acre, except when competitive bidding ran it up higher. Men bought not only for themselves, but for friends who were not on the grounds and also for speculation.

An agent was allowed to enter five or six quarter sections at a time. His commission on a quarter was

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1. The Eagle under date of November 28, 1857, gives a column to the report of this banquet. Nineteen men are named as having been present, Mr. Sanborn's name not being among the list.

about $40. A common plan was to enter a quarter section at $1.25 per acre and sell it at once on a year's time for from $2.50 to $3.00 per acre. By going east an agent could sell such a piece for $4 an acre. There was much politics in the land business. Agents were partial and not all comers were treated with equal fairness.

ADMITTED TO THE BAR.

Early in 1858 Col. Means and myself were admitted to the bar. He had some knowledge of the law, but I had none except what little I had picked up while I was Justice of the Peace.

But the boys were bound to have me be a lawyer, so Col. Means and I gave a supper. Judge Marshall F. Moore of the District Court presided. He appointed a committee to examine us. They asked us only one or two questions, and then certified that we had passed our examinations. In this way we were admitted to the bar, or, as the boys put it, we were admitted to be "eternally at law and solicitous of good chances."

I never practiced law in spite of my highly successful examination for admission to the bar. In fact, about the only advantage I received was to escape jury service thereafter.

INDIANS. SOLDIERS. GRASSHOPPERS.

In May, 1861, I was appointed by President Lincoln Indian agent for all the Indians on the Upper Missouri River. I did not accept the appointment because I was to be married the next week in Ohio, but I still have the commission in my possession.

In July, 1861, we had an Indian scare here. On the 9th the Inkpaduta band[1] of the Sioux rose and murdered Thomas Roberts and Henry Cordway [Cordua] in Bacon's Hollow, now Greenville, while they were in their fields hoeing corn. It caused a great flurry among the people and stirred them to action.

1. Renegade Indians of the tribe of the Santee Sioux, undoubtedly, but probably not of the followers of Inkpaduta.

A greater Indian scare[1] occurred in 1862, when the Santee Sioux rose and massacred the inhabitants of New Ulm, Minn. As the Indians proceeded west from New Ulm into Dakota the settlers along the Big Sioux and James Rivers began to leave for Sioux City and the east. They abandoned their crops and newly made homes in such large numbers that the region was almost depopulated. Much plunder was left to the Indians for the taking.

We, in Sioux City, did what we could to stop them. We placed a guard at the ferry across the Floyd River in order that their retreat might be cut off, but it was of no avail, for they would not be stopped. A stockade was built in Sioux City on the river front between Douglas and Pierce Streets. Every man in town was expected to help in the work of making the town safe. But the Indians never came near us after that and gradually fear died away. Some of the settlers who had fled never came back. Others returning later found that their claims had been jumped in their absence. Altogether these Indian scares were very expensive.

In the fall of 1862 came the soldiers, parts of three companies, to protect us from the Indians. At first they had a tendency to stop the wholesale departure of settlers, but, finally, when they began to help themselves freely to everything they could find, it was neither pleasant or helpful to the town. By and by they left us and went south.[2] We were rid of them and still lived.

Next came the grasshoppers.[3] They were almost as bad as the Indians and soldiers. They mowed down field after field of corn; in fact, they ate up nearly all vegetation, causing much suffering and distress.

It did seem hard upon us to be preyed upon by Indians, soldiers and grasshoppers in such rapid succession. These were lean years for us in Sioux City. It was enough to make even the stoutest hearts quail.

1. Called the "War of the Outbreak" in the history of South Dakota.

2. They were, rather, sent up the river. Later they were mustered out at Sioux City.

3. Fall of 1864 and spring of 1865.

DAKOTA TERRITORY.

In 1861 Dakota Territory was organized. Settlers had been going into that region for several years. Most of them passed through here on their way. Sioux City was also their depot of supplies, a kind of headquarters or capital for that territory. Some of our people went over there to settle. When Indian troubles threatened Dakota settlers fled here for refuge. Hence Sioux City and Dakota Territory had much in common in those days.

The settlers in Dakota used to be jealous because their judges and other officials often lived in Sioux City while holding office over there. But it was better living here and I couldn't blame them.

We used to go over there at election times to see that some did not vote too often and that all got a chance; in fact, to see that no frauds were permitted. At the first election in Dakota, after the territory was organized, for the choice of a delegate to congress, J. B. S. Todd was a candidate and was elected. His opponents were [A. J.] Bell, regular republican, and Chas. P. Booge, independent. Todd was the people's candidate. He had been elected first mayor of Sioux City four years earlier and his friends here were interested in his candidacy. I recollect that some of us went over the river when election day came to watch the proceedings. Todd was there,[1] but later in the day he went up to Vermillion and left me to look after his interests. The Frenchmen fell out and began to quarrel and fight and had an awful time. I wouldn't go through that experience again for all Dakota. Finally, when the votes were counted, it was found that less than 1,000 had been cast, but of these Todd had received a majority, and so was elected.[2] Todd had hardly gone down to Washington before he came back appointed by President Lincoln a Brigadier General and went into Northeastern Missouri to fight the guerillas.

BUSINESS INTERESTS.

During my first four years in Sioux City, i. e., from 1856 to 1860, I was engaged in the real estate business.

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1. At Sioux Point, where Frost, Todd & Co. had one of their stores.

2. The vote stood: Todd, 397; Booze, 110; Bell, 78.

I also did considerable surveying. During most of this time I was closely associated with Geo. W. Ryall, who had been a friend in Ohio. Our office was situated on Pearl Street, across from the Sioux City House.

In August, 1860, I consolidated my business with that of Means, Allison & Co. The firm name was Allison & Charles. Our office was located on the lot where the public library building now stands. I remained in this firm but one month, selling out on September 6th to Geo. Weare, who is still in the banking business in Sioux City, the oldest banker here and a good one.

I at once entered the general mercantile business of Milton Tootle as a clerk. I received $65 per month. The store was on the corner of Second and Pearl Streets, and faced the river. Tootle lived in St. Joe, so I was virtually manager of the store. In 1864 Mr. Tootle recognized this and I became a partner with him in the business, the firm name becoming Tootle & Charles. I was now manager in name as well as in fact. We did a large general business, picking up considerable river trade. In 1871 new interests came into the firm, and the name became Tootle & Co. Our steamboat business, which was very attractive to me, now increased rapidly.

In 1875 I left the firm of Tootle & Co. and formed a partnership with A. H. Wilder, of St. Paul. This time the firm name was Charles & Wilder. We owned four steamboats, which ran between Sioux City and the upper river. We carried freight for Indian traders and miners and took government contracts to supply Indian tribes with their annuities.

Five years later [1880] I helped organize and became interested in the Benton Transportation Company. I became secretary and manager, holding those positions till July 1st, 1900, when the company ceased to exist.

Our business was entirely that of steamboating. From a large business at first, requiring as many as eight steamboats to handle it, we came at last to have almost none, owing to the building of railroads into the West. At the dissolution of the Benton Transportation Company I retired to private life.

STEAMBOATING ON THE MISSOURI.

The steamboat business was fascinating and romantic. The Missouri River is very treacherous, the channel always shifting. To be a pilot required great skill and courage. The pilot was extremely well paid. But the river was not the only danger. Some of the Indians on the upper river were extremely hostile. It required great courage on the part of the captain, too.

When the steamboats first began to come up the river they were a great curiosity to the Indians and were warmly welcomed, indeed, by the whites. The approach of a steamboat was generally known long enough in advance for a good sized crowd to greet it at the levee when it came to land.

The first steamboat to come as far up the river as Sioux City was the Yellowstone, in 1831. In 1863 two new factors entered in, which increased the number of boats on the river very much. Fully sixteen or eighteen boats were doing business on the upper river, between here and Ft. Benton, in 1863. One reason for the increase was the discovery of gold in Montana, which called for a large amount of manufactured articles as well as for provisions. All freight destined for the mines was taken up the river to Ft. Benton and then hauled by teams to the camps. The second cause was Indian troubles. After the New Ulm disaster in 1863 the U. S. Government tried to punish the Indians. Gen. Sully was sent up the river in 1863 and still more troops followed in 1864.

The business increased in 1864 and 1865 and then fell away again, until 1868, when it reached high water mark.

In the spring of 1864 the first boat up took from our house express packages valued at $6,000. The transportation charges on the goods were often equal to their value. Everything, from the needles needed for sewing their buckskin to steam engines used for crushing quartz, had to go up the river by boat and had to come by way of Sioux City.

The orders which we used to get were something to be wondered at. Upon one occasion one customer ordered a marriage license and another a tombstone. All sent to me, supposing I could get them whatever they wanted.

The trade was so good that the public soon got its eye upon it. Competition set in, and became very keen. The Union Pacific hurried up construction on its western division so that traffic would go to Salt Lake by rail and thence to Montana by wagons.

I recollect the first gold brought back from Montana in 1862. The party owning it came down the Missouri in boats, which they abandoned here, and proceeded the rest of their way east by stage. I met one man in the party whom I knew. He was an old blacksmith from Mansfield, Ohio. Mr. Thompson, for that was his name, sat and told me stories of the far West for two or three hours. From Sioux City he went by stage to Dubuque and thence to St. Paul.

After the railroads reached Sioux City in 1868 steamboating revived here and became better than ever. A regular line of boats made this their headquarters. Cargoes coming here by the railroad were then reshipped and made the rest of the journey to Montana by boat.

Finally the Utah Northern was completed into Montana. Then, in 1870, the Northern Pacific was built and we were cut off all around. The steamboat business, which was at its height in 1868, began to decline about 1870 and by 1875 it was practically a thing of the past.

FAMOUS MEN RECALLED—SCIENTISTS.

In the fall of 1868 or 1869 I met Audubon as he came down the river, returning east after an expedition to Montana. He was accompanied by Louis Agassiz. Audubon was old and feeble and did not stop here, but continued down the river. Agassiz, who was in the prime of life, stopped off for a couple of days. Sioux City was the first railway station then as one came down the Missouri. From here he went by rail to Chicago. While in town Agassiz spent most of his time in the office of Doctor A. Lawrence, the owner of a line of steamboats. It was there that I met the great naturalist and had several talks with him. He was neither tall nor robust, though he enjoyed good health and was a very hard worker. In his dress I found him a little careless. He was smooth shaven while here and wore glasses when reading.

Completely absorbed in his own thoughts he was a poor conversationalist. Indeed, he was rather impatient with callers, or at least that was what several of us thought who honored him by dropping in to see him. Perhaps if our acquaintance had been longer I could not have said that.

Prof. [E. D.] Cope, of the University of Pennsylvania also stopped off in Sioux City on two of his Missouri River trips. With him I became quite well acquainted. Some time before his first visit a boat pilot had found, way up the Missouri River, some of the bones of a plesiosaurian. He brought them down to Sioux City and I gave him $25 for them. When Prof. Cope was here I gave the bones to him. Later he printed a description of the bones in a paper published by the University and in it he gave me a complimentary notice.[1]

Prof. Cope was intense, very much wrapped up in his subject [zoology]. He could hardly talk anything else. During his second visit here a trip up the Big Sioux was arranged by D. W. Jenkins, Perrin Johnson, Geo.

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1. The paper in question was entitled, "On the Structure of the Skull in the Plesiosaurian Reptilia, and on Two New Species from the Upper Cretaceous," by E. D. Cope. It was read before the American Philosophical Society on Febraury 2, 1894, printed in the Proceedings of the American Philosophical Society, Vol. 33, and reprinted in pamphlet form on March 6, 1894. The paper is a description of two specimens. One of these, termed "Embaphias circulosus," is declared to be both a new genus and a new species. After the description and measurements occurs this paragraph: "This is a species of large size, though not equal in dimensions to the known species of Elasmosaurus. It was found in the upper cretaceous bed of the Pierre epoch, at the big bend of the Missouri river in South Dakota. It was presented to the Academy of Natural Sciences by Mr. John H. Charles, of Sioux City, together with the remains of Elasmosaurus below mentioned. I wish to express my sense of the obligation under which Mr. Charles has placed the academy and myself by his liberality in this and other matters."

The second specimen, termed "Elasmosaurus intermedius," is declared to be a new species. Following the description and measurements occur the words: "This specimen was found with that of the Embaphias circulosus at the Big Bend of the Missouri in South Dakota, and was presented to the museum of the Academy of Natural Sciences by Mr. John H. Charles, of Sioux City, Iowa."

W. Felt, Prof. Cope and myself. On the morning of the proposed trip Cope came to my house after me before I was up. He seemed much interested in all we had to show him.

Prof. Cope was a German looking sort of a man, with black beard and eyes. His appearance was neat. He was of wiry build, a good conversationalist, a traveled-polished student and gentleman.

When the old Scientific Association, the parent of the present Academy of Science and Letters, was in its second year, having some money in the treasury, we decided to secure some noted man for a course of lectures. At the suggestion of D. H. Talbot, one of our charter members, correspondence was begun with Alfred Russell Wallace, the great English scientist, who was then in this country. The result of the correspondence was that Mr. Wallace, after finishing an engagement in New York State, came out to Sioux City and gave us a course of four or five lectures upon the subject of Evolution.[1] We threw the lectures open to the public, and they were well received.

Several of us became quite well acquainted with Mr. Wallace during his stay of a week in Sioux City. We found him a typical English gentleman in every particular. He was a much traveled man of wide acquaintance. He understood himself and had confidence in himself. Though nothing of a society man he was easily approached by friends. Only those who felt antagonized by his views had any reason to feel his reserve.

Polite, genteel, neat in dress, he stood six feet high and was built in proportion. At the time of his visit here he was wearing a closely cropped beard.

Wallace was not an orator, not even a smooth speaker. He spoke carefully, without notes, and always kept within bounds. His lectures were strictly scientific. It was what he said, rather than how, that attracted. He was a pleasing conversationalist, one not given at all

1. Mr. Wallace delivered but three lectures before the association. They were entitled, "The Darwinian Theory," "The Origin and Uses of Colors in Animals," and "Oceanic Islands." This was in the spring of 1887.

to small talk. Though it was hard for him to get away from the subject of evolution, I do not remember that he spoke a single time while here concerning his own great part in the working out of the evolutionary hypothesis.

Wallace's outdoor habits clung to him while he was here. He spent several days in the woods. I remember that he was greatly interested in the grasses on the Talbot farm and in the drift deposits along the Big Sioux.

EARLY POLITICIANS.

In the fall of 1859 Saml. J. Kirkwood, republican candidate for governor, and A. C. Dodge, democratic candidate for the same office held a joint debate in Sioux City. I met and became acquainted with both gentlemen. Abe White and I went down below Sergeant's Bluff and met Kirkwood, who drove in, and brought him back to Sioux City. Dodge came in a little later on the stage from Council Bluffs.

Kirkwood was a farmer. and looked it. He wore course shoes, no stockings and flannel shirt. But though he was simple and plain he was also honest and straightforward, and so impressed people. He took well here. Though he didn't carry the town, because of the big democratic majority here in those days, he succeeded in reducing that majority considerably. He was elected governor.

Dodge was the son of a United States Senator from Wisconsin. He, himself, was one of Iowa's two first senators. He became a United States Senator when Iowa became a state, in 1846. He was re-elected once. Then he was succeeded by James Harlan, a republican. He was nominated by his party for governor in 1859. It was thought that his services to Iowa in Washington, D. C., both before and after the state was admitted would elect him governor, but they didn't. He was just the opposite kind of a man from Kirkwood. He was very dressy, with his patent leather boots, white shirt and starched collars. In fact, he was quite a gentleman and aristocrat. He was a good man, however, and smart. In speaking he was earnest, but a little rhetorical. He was made much of here by his party, and probably lost votes here only because opinion in Iowa was turning strongly to the republicans.

Geo. W. Jones, of Dubuque, was Dodge's colleague in the United States Senate. I knew him better than I did Dodge. Jones was interested in the establishment of Sioux City. He owned one-eighth of the town, and was the most important factor in getting governmental legislation favorable to the place. He did many things of advantage to the town; in fact, he was a sort of patron saint to Sioux City.

Jones used to come here very often. I remember that in the spring of 1857, while he was yet a United States Senator, he went up the Missouri river as far as Ft. Randall. On his return he left the boat here, and went home to Dubuque, across the state.

Senator Jones was a good looking man, small in size, but well built. He must have been about 50 years of age in 1857. To me he looked like an Englishman. He did not impress me as a very remarkable man, and yet he must have been, though Dodge was the brainer of the two men, I think. Jones was more democratic or common in his dress and appearance. He was not much of an actor, was easy to get acquainted with and had a strong hold upon the people. Dr. S. P. Yeomans was his best friend in Sioux City. Yeomans was in the legislature at the time of Jones' last election to the United States Senate and cast the decisive vote for him for that office. Jones made Yeomans first register of the United States land office in Sioux City.

INDIAN TRADERS AND RIVER PILOTS.

One of the most interesting characters I ever knew in this Northwest country in the early days was Charles Larpenteur, a French Indian trader. I say a Frenchman, but since he spoke German as fluently as he did French it is my judgment that his ancestry was Swiss-French. Larpenteur came from the region of the St. Lawrence River to the Upper Mississippi, where he traded for a time. Then he changed over to the Missouri River. At first he worked for the company of Pierre Chouteau, of St. Louis, but later for himself. While in the employe of Chouteau he was stationed as agent at various places up the river, among them Ft. Union, at the mouth of the Yellowstone. I knew Larpenteur well. He purchased goods of me for his trade with the Indians for several years.

He was a delicately built man, though his life was one of much hardship. I believe he was thoroughly honest and upright. If he was more conscientious, he also had more refinement than the majority of the French Indian traders. His wife was an American woman. At the trading business he was very successful, so I think he did not lose because of his honesty.

In 1848, on thereabouts, Larpenteur settled at a ford on the Little Sioux, in Harrison County, Iowa. This particular ford was on the route from Sioux City to Council Bluffs. A little town grew up around him, which he called Fontainbleau. There he lived till 1873, farming in the summer and trading up the river with the Indians in the winter season.

Larpenteur was alive to the romance of his career. He kept an interesting journal, which has since been edited by Coues and published by Harper. It is very interesting to me.

Two of the most prominent men ever connected with the fur trade of the Northwest and with the business of steamboating on the Missouri were Pierre Chouteau, Sr. and Jr. They were Frenchmen, descended from the men who first settled and laid out St. Louis. The father first traded upon the Upper Mississippi, but later transferred to the Missouri. He built the first steamboat on the river, and ran it up to the mouth of the Yellowstone in 1831, astonishing the natives and everyone else who saw it.

When I came to Sioux City they were the principal men doing business on the Upper Missouri. Of course, they always had competition, but it never amounted to much. I did business personally with Pierre Chouteau, Jr., and so was acquainted with him, but not with his father.

I was better acquainted with some of the steamboat captains and pilots than I was with the principals whom they served. Two of the greatest pilots that ever guided a boat up the Missouri River were Joseph and John La Barge, two French brothers, who lived in St. Louis. After serving the American Fur Company for years they at length purchased boats of their own and operated them independently. For years they stopped at Sioux City both fall and spring. Our house acted as their agents here. John La Barge, the younger of the two, died in the service of the Benton Transportation Company. Joseph, the elder, continued steamboating till the early nineties, when the business languished and finally died. His career was as long as that of the business he followed. In his "History of Steamboating on the Missouri River," Col. Chittenden weaves his story around the life of Joseph La Barge, and makes a hero of him. While Joseph was older and was the head and front of the La Barge interests, still John was a steamboat pilot and captain whom everyone looked up to. In my opinion he was as good a pilot as any the river every had. He was a man of undoubted veracity and good character, too.

Joseph was a large, portly man. He used glasses and always wore a beard. He was a man of few words, much more dignified and reserved than John, who for this very reason was the more popular.

LOCAL CHARACTERS.

Among the first men I met after I came to Sioux City was Dr. John K. Cook. He was a man of splendid physique, an Englishman by birth, educated as a physician. He came here in the early days as a Deputy United States Surveyor. It was said that he came to this country for the purpose of joining the Mormons, but of this I have never seen any definite proof. He was a man of good habits, considering that everyone on the frontier drank whisky and chewed and smoked tobacco; all of which he did, but with moderation.

Cook was the first postmaster of Sioux City, and it was said that he had his office in his hat and handed out letters to the citizens whenever he happened to meet them on the streets. I can't vouch for the truth of this statement, for when I came here Mr. [S. T.] Davis was assistant postmaster, and whenever the mail came in he blew a horn and we all went at once to the post-office, on Second Street, between Pearl and Water, and the mail was distributed.

At this time Cook was about fifty years old and a married man. He was easy-going in his habits and very popular. For a number of years he was the only practicing physician here, and was very successful. I doubt if he ever made out a bill in his life. He was not much of a surveyor, though he did plat the first edition of Sioux City. He was a member of the first company which owned the town. His share was one-eighth. He disposed of his interest too soon, and hence did not make much out of it.

Probably the oldest settler within the present limits of Sioux City was Theophile Bruguier, a French Canadian, who lived on the river here for several years prior to the founding of Sioux City. From Canada he went to St. Louis, where he entered into the service of Pierre Chouteau [Sr.] and became a fur trader, his field of operations being the Upper Missouri. He became very intimate with the Indians, in fact he practically lived as an Indian until the whites came to this locality in large enough numbers to plant a colony.

Long before the Indians left this vicinity Bruguier settled at the mouth of the Big Sioux. This was about 1849. He had married a daughter of War Eagle, chief of the Yankton Sioux, and when she died he married a second daughter. War Eagle lived with him till he (War Eagle) died, whereupon he was buried upon the bluff along the Big Sioux, this side of Bruguier's place. Bruguier had lots of children, half-breeds of course, but they turned out to be the worst kind of Indians. Sometime after the whites came Bruguier went to St. Louis and married a French woman. He brought her up here and lived with her till he died. She made him a good wife.

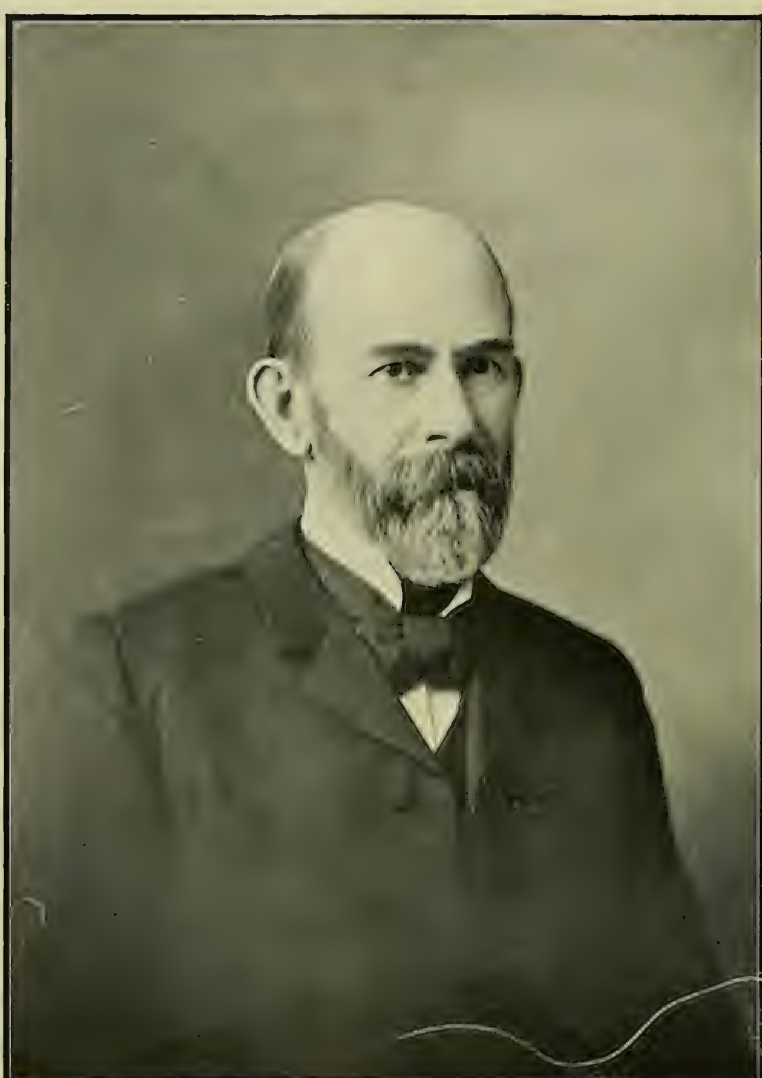
Bruguier was a large man, with black hair and beard. He was careless in his dress. His education had been neglected. He was a good-hearted man, but his ideas of right and wrong were peculiar. They were not as well defined as they should have been, but it cannot be said that the frontier was the best place in the world to develop morals. Those pioneers, many of them still living, but rapidly falling off, who came through it all morally sound, were true men, indeed.

Bruguier was a sociable man, rather talkative. I think he was a little inclined to paint his stories to suit the occasion in hand. He especially liked to tell what "I done to the Injuns."

One of the most influential men in Sioux City when I came was J. B. S. Todd, early settler, trader, land speculator, politician and soldier. He was elected first mayor of Sioux City, but did not serve. Later he moved across the Big Sioux, his object being to get land in Dakota and become rich by holding it. He had seen land values rise in Iowa and expected the same to occur in Dakota. They sent him to congress as the first delegate from Dakota Territory, after its organization in 1861. He didn't stay long, but soon came back, appointed a brigadier general by President Lincoln. Todd was a democrat in politics, but supported President Lincoln, who was a relative of his by marriage.

Todd was in partnership with a man of means who lived in St. Louis. The firm name was Frost, Todd & Co. They had stores at Sioux Point, across the Big Sioux, at Vermillion, at Yankton Agency and Ft. Randall.

Todd was a tall man, but slender. His health was not good. He had been sickly from birth. He wore while here a full beard, reddish in color, like his hair. Educated at West Point he was a very capable man. He always passed as a gentleman, was sociable and very popular. His one fault was a common one here at that time, he couldn't let whisky alone.



GEORGE W. WAKEFIELD.

GEORGE W. WAKEFIELD.

BY C. R. MARKS.

George Washington Wakefield, who was an active member of the Academy since its first organization as the Scientific Association down to his death, deserves mention in these pages.

He was descended from sturdy New England stock. His first American Wakefield ancestor was John Wakefield, a shipwright and boatman, who came to Boston, Mass., before 1640. The family for many generations resided in Massachusetts and Eastern New York. One of them, Joseph Wakefield, was a soldier in the Revolutionary Army, and was in the battle of Bunker Hill.

Orin Wakefield, father of our member, migrated to DeWitt, DeWitt Co., Ill., where he died in 1885, at a good old age. His principal occupation was farming. George W. Wakefield was born at DeWitt, Ill., Nov. 22, 1839, and he spent his youth upon his father's large farm, pursuing the usual routine of such a life and attending the public schools for his early education.

He must have been in these years a close observer of nature, as throughout his life he was always testing the accuracy of his conclusions upon subjects of study by what he himself had observed. When eighteen years old he commenced attending school at the preparatory department of Lombard University, Galesburg, Ill., remaining there several terms and returning again at intervals thereafter.

On July 27, 1861, he enlisted in Co. F., 41st Illinois Infantry, and was mustered into the United States service as corporal. He was taken down with fever and went to the hospital the same fall, and was not able to rejoin his regiment until the latter part of Feb., 1862. He thereafter served with the regiment until mustered out, August 20, 1864, with the rank of first sergeant. He actively participated in the campaigns of the Western Army and was in many engagements. Among these, the battle of Shiloh, the sieges of Corinth, Vicksburg and Jackson. He was wounded in the charge of Lauman's brigade at Jackson, Miss.

He was never boastful of his military achievements, but when talking with his comrades of some war time engagement they had participated in, his eyes would brighten and his voice take on a shade more emphasis as he would give some precise detail of what part his regiment had taken in some march or battle, nothing had escaped his keen observation.

After he was mustered out of the army he attended Lombard University, taught school and studied law. He pursued his legal studies mostly at home, going to the county seat twice a month to recite and review his studies with his preceptor, Hon. Henry S. Green. After two years of legal study, he was admitted to the bar by the supreme court of Illinois in January, 1868.

He soon after started for Iowa, and reached Sioux City March 6, 1868. The first railroad had just been completed to Sioux City, and it was then looked upon as a place likely to make a thriving city. He was really the first new lawyer to arrive in the town since 1858, coming soon after the revival which followed the advent of the railroad. He entered the office of Hon. Isaac Pendleton, who had been in Sioux City ten years and who was the last arrival of the older set of lawyers. The principal attorneys in 1868 were Wm. L. Joy, John Currier and Isaac Pendleton, although O. C. Tredway and Samuel T. Davis practiced to some extent, but had too much other business of their own to devote much time to practicing law.

With the opening of the railroad large numbers of settlers came into Northwestern Iowa to take up homesteads on the large tracts of vacant lands. And the United States land office was located in Sioux City, so there was really more practice for a lawyer in contested entries before the land officers than in the courts and conflicts with the numerous railroad land grants and swamp land grants opened up an extensive field of legal controversy. The young lawyer, Wakefield, was soon deeply engaged in these matters, and there laid the foundation of his knowledge of the public land laws of the United States, which were the foundation of all land titles here. He was without doubt the best informed lawyer in Northwestern Iowa upon matters pertaining to public lands.

The office of County Auditor had been created by the Iowa Legislature in 1868, and Mr. Wakefield was the first person elected to fill this office in Woodbury County, Iowa, in the fall of 1869. He held this office two terms, and then continued the practice of law from 1874 to 1884, a portion of the time with S. M. Marsh, who was District Attorney for the Fourth Judicial District.

He had been married October 29, 1873, to Kate Pendleton, sister of Hon. Isaac Pendleton. In 1884 he was elected Judge of the Circuit Court of the Second Circuit of the Fourth Judicial District of Iowa and upon the abolition of that Court in 1886, he was elected District Judge of the Fourth Judicial District of Iowa, which office he held by repeated elections up to the time of his death in March, 1905. He left two children surviving him, a son, Albert O. Wakefield, an attorney at Sioux City, and a daughter, Bertha Wakefield. His wife died many years before he did.

Judge Wakefield was a man of wide culture, and all his life he was investigating science, history, literature and religion. The knowledge thus gained was not a mere accumulation of facts, but material from which he was continually evolving fresh conclusions.

He was never, as an attorney, very much interested in the trial of jury cases, his was not a belligerent nature and wordy controversies were not to his taste, though he was not deficient in that part of the practice. He studied his cases carefully and prepared his pleadings with great skill and clearness, and in this, as in all his literary work, he was exceptionally talented in his written compositions. He aimed to state any proposition clearly with all the fine shades and distinctions of meaning, and was equally successful in scientific and humorous writings.

In equity cases, both as a lawyer and judge, he was at his best. He was clear and logical, and in all matters pertaining to real estate and corporation law was especially strong; and while not aggressive in his nature, he was stubborn and tenacious in holding to his views, and his wide knowledge of other subjects aided him in his judicial work. In the preparation of his instruction to juries he was careful and availed himself of his past experience until he had collected a private book of instructions upon all classes of cases and phases of different subjects that had stood the test of the higher courts, which are and will be models for his associates and successors.

He was uniformly courteous, patient and kindly to all and freely gave his time and advice to any who sought him. He took pride in helping the young man to make his start in life, and the young lawyer especially found in him a friend and a judge who would grant him a patient and attentive hearing. His anxiety was not so much concerning the law as that justice should be done.

He was an early member of the original Scientific Association and was president of this Academy at the time of his death. He contributed many papers upon a wide range of subjects, scientific, historical, religious and literary. He was always interested in geology and botany, and every rock, tree, hill or valley attracted his attention and was absorbed, as it were, into his storehouse of knowledge.

He had quite a gift in poetry and composed some very choice poems. He published, in pamphlet form, some of his literary productions. He prepared papers which he read before the State Bar Association. One of these has been regarded as a masterpiece of pure elegant English writing.

In social life he was a most genial companion, quiet, unobtrusive, yet glittering with quick suggestion and apt repartee. His eye was peculiarly bright and observing and he might sit a long time quiet, while others were absorbing the conversation, but nothing escaped his vigilant eye.

As years advanced his industry increased and his judicial labors were very onerous, and he failed to take the needed relaxation from these duties in social intercourse and out-of-door exercise. Having been bred on a farm, he was strong physically, but the mental spur of literary work unfinished, kept busy with his private studies and writing, the hours that should have been devoted to leisure, his health failed and death claimed him.

To his friends and associates, he has left the memory of a life well lived, a character unsullied, a heart filled with kindness toward all and a soul that ever led the way to the higher life.

THE IMMORTAL SOUL OF MY DOG.

BY H. C. POWERS.

The Immortal Soul Of My Dog! A queer expression, isn't it? I am afraid some of my orthodox friends might use a stronger adjective than I have and call it a blasphemous expression. But it is only an expression and not an assertion. I don't say the dog has an immortal soul, but I can express my own belief so far as this. I fully believe the dog's chances for such a possession are at least as good as mine. But there is little use of crediting the dog or myself with the possession of a soul until we know what a soul is. If I were to ask of twenty persons whom I might meet this question, what do you understand the word soul to mean? what do you suppose the answers would be? I cannot tell you the exact words of these answers, but I can say this much concerning them. Those who had thought least on the subject, who had accepted the opinions of others instead of forming an opinion of their own, these would answer my questions most readily. They would be ready to describe in detail a true anthropomorphic conception of a soul, together with its home in an anthropomorphic heaven. Their idea of an immortal soul would be what Huxley called a gaseous vertebrate. And this class would be composed almost entirely of good Orthodox Christian people who would have no doubts as to church doctrines or creeds. Then there would be another class who would have some opinions of their own on the question I had asked them. These would be persons who had in their youth been taught the doctrines of the church, but who in their more mature years had read the writings of others, and who had thought much on the subject and had begun to doubt the entire truth of their earlier acquired beliefs. These would hesitate more in their answers to me, and their statements would be much less positive than those of their more Orthodox friends. Then there would be still another class who were studious and thoughtful, who read and thought much on scientific subjects. If I were to ask a truly scientific man or woman, what is an immortal soul, they would at once reply: "I do not know." The reasons for such answers to this question are easy to understand. Many devout church members, having been steeped in Orthodox teachings which have been accepted without question, simply give out in answer what has been taught. Human gramophone records are found everywhere. A good lady, a devout church member, said to me when speaking of the theory of evolution, "I don't believe in evolution because I do not want to believe it." Such a person would be very sure to answer my question concerning the soul as I have stated above. Her faith would bear her over any adverse truth that she did not wish to believe. And I should be sorry to disturb the faith of such a person. It satisfies them and doubtless adds to their happiness.

But the true scientist, who had pondered and studied deeply over the problems presented to his mind by the phenomena of nature as he observed them all about him, would wisely disclaim any knowledge of the immortal soul. All the knowledge human beings can obtain must be presented to consciousness through the bodily senses. Again all our knowledge must be relative. None of it can be final. In whatever direction we pursue our study, we reach a final and impassible barrier, beyond which we cannot go. All we learn must be like or unlike what we have previously known. Now in speaking of the immortal soul, what can we compare it to? We can study mind in its various manifestations and learn very much concerning it, because it is inseparably connected with our brain. Not one of us can conceive of what we know as mind disconnected with body. In all our human experience mental phenomena are always connected with physical phenomena. The German writer Moleschott said in one of his books, "No thought without phosphorus." As phosphorus is an important constituent of the brain, this saying is entirely in accord with our human experience. But do not think for a moment that because brain and mind are always together that they are in any way linked together as cause and effect, that brain secretes thought as the liver secretes bile. Brain action and mental action run parallel to each other, but their paths never intersect. We frequently hear it carelessly said that mind is a function of brain, and Haeckel makes this statement frequently in his books. There is no truth whatever in this statement. Neither brain or mind are functions of the other, although in all our human experience we find them united in the same body. This statement may be new to some, as many suppose mind to proceed in some way from brain as both are found together in all our human experience. The brain is very commonly spoken of as the seat of the mind. I will try and make my statement clear to you and show why mind and brain should never be considered as functions of each other, or either as the cause of the other. Near the middle of the last century scientists discovered and gave to the world two theories which have produced remarkable results in two of the foremost sciences. These two theories were the "Indestructibility of Matter" and the "Conservation of Energy." According to the first, matter can neither be created nor destroyed. It is and has ever been fixed in quantity in the cosmos. It may be changed in form and appearance, but not increased or diminished in quantity. When a lump of coal is burned the ashes and gases arising from combustion weigh precisely what the coal did plus the oxygen which united with it in the burning. The second theory holds that energy or force is also constant in amount. It may be manifested in several ways and can be changed from one mode of manifestation to an other. We know it as heat, light, electricity, chemical action or gravity. It cannot be created nor destroyed, nor can it be changed except in form of manifestation. These two theories have become the foundations of chemistry and physics, and are as fully accepted and believed as is the theory of gravitation. The theory of the conservation of energy is the one with which we are interested in this paper. It has also been learned by specialists in brain physiology that every thought passing through the mind is accompanied by a molecular change in the cortex or outer part of the large fore-brain or cerebrum. That is the atoms composing this part of the brain are changed in position in relation to each other. Any change in position of matter, whether atom or planet, implies force as the cause of motion. But while force may be changed in the mode of its manifestation, it must still remain force or energy, and can by no possible cause be changed into something else. This being the invariable case, it is utterly impossible to conceive of or measure a thought or an emotion in terms of force. Thus the statement that mind is a function of brain is in direct opposition to the theory of the Conservation of Energy.

I have already said that all our perceptions are presented to consciousness through the bodily senses. These senses as parts of the body are finite and mortal and, therefore, can have no claims to immortality. When the body dies, the mind, so far as we have any positive knowledge, ends also. In all that I have said thus far I do not wish you to understand me as offering a single argument or a particle of proof against our possession of an immortal soul. I only try to show that we can know positively nothing concerning the soul, neither in the affirmative or negative. I hope and believe fully in a continued life after this one ends, and, although we can offer no proofs of its existence, we should remember that the negative of a proposition must not be assumed because of a lack of evidence unless that evidence is attainable.

We are now where we started, as we can know nothing of an immortal soul possessed either by ourselves or the dog. But there is another line along which we can investigate the question as to ourselves and the animal world about us. If I were to say the soul was analagous to the mind except that it was not connected with the body I think most persons would agree with me. Starting from that standpoint, if we confine our study to mind we shall be on safe ground. Mind, we have with us and can study it in all its various manifestations. I believe that by nearly all of us the three words mind, soul and spirit have a synonomous meaning, so that our study of mind will be as nearly a study of soul as is possible to us.

I assume that my hearers accept and believe in the theory of evolution. It is so generally believed to be true by all educated persons that I shall offer no arguments in its defense. We may and probably do not fully understand all that it implies, but neither do we fully understand the theory of gravitation, but it would be hard to find an intelligent person who disbelieves the theory as given to us by Newton. Evolution rules the whole cosmos. Every atom in our universe is in ceaseless motion, acting upon and being acted upon by surrounding atoms. Nothing is dead or inert. Now is mind as we know it, a product of evolution as well as body? Every student of science will answer this question in the affirmative. There can be no other answer. We all know that mind is a growth. Every human being comes into this world with only a potential mind. The physical apparatus that we everywhere find in connection with mind is not complete at birth, and, therefore, mind can only appear later, when its complementary physical organs through which it is manifested are completed and ready for their work. This is the individual history. Do we find the same facts in the race history as in that of the individual? There can be but one answer to this question. As we go backward and downward toward the less civilized, the barbarous, the savage, and to primitive man, we find the manifestations of mind growing less and less until we reach races of men whose minds are little, if any, above those of the more intelligent animals that are with us. Now if we find the body and mind of man to be the products of evolution, that man is a direct descendent of animal ancestors below him, then we cannot by any reasonable thought believe otherwise than that he inherited his mind as well as his body. We cannot believe that when man appeared, the final and highest link in the long chain of organized beings that have lived on our earth, that there was some kind of a supernatural interference with the immutable laws of nature, through which he received a new and different mind from his immediate bodily ancestors. If, as we must believe, he inherited mind as well as body, then his animal ancestors certainly possessed mind for him to inherit. And as mind wherever we see its manifestations is always the same in kind but differing in degree, we must assume that the animals below man have the same kind of mind that we possess. By just two gifts has man reached his high position in the organic world. His spoken and written language has enabled him to develope his mind so far in advance of his more lowly animal friends. No other organic being on this earth has this gift. It is true that all animals have sufficient language to communicate with each other as far as their more lowly life calls for. Then the second gift by which man has reached his present position, and fully as important as the first, is his hands. Can you imagine yourself without speech or hands? What could you do without these superlatively important gifts? Think of a dog with the brain of a Spencer or Fiske, but with his present physical endowments. How much could he do that man has done?

I have already said that in all our study of mind we always and invariably find it associated with brain. Without brain, as far as we can know, there can be no mind such as we possess. Any injury to the brain, either by accident or disease, at once is shown in the manifestations of the mind. This being the case, then we have the right to and we must assume the possession of mind by every organic being having a brain. All the vertebrate animals below man have a brain, spinal cord and nervous system as man has. The mammals are above the birds, fishes and reptiles. These higher animals, the mammals, are affected by narcotics, such as alcohol, ether and chloroform, and can be hypnotized, just as is the case with man. The mind of these highest placentals such as the ape, elephant and dog, differs from that of man only in degree and not in kind, and the graduated interval between those animals nearest to us in intelligence and the lowest races of men is much less than the corresponding interval between the lowest races of men and the highest specimens of civilization, such as Fiske, Spencer and Darwin.

It is hard for us to overcome the prejudice inherited from the past generations of men and look at this question in the light of our greater knowledge of the present time. Only a few centuries ago man, in his egotism, claimed for himself the center of the universe, with sun, moon and stars created for his special benefit, wheeling around the earth as a center. Today we know more of nature's laws, and have learned that man, while the last and highest product of evolution, is only one of the almost infinite number of organized beings that have had their home on this earth, itself only a tiny speck among the myriads of other like bodies filling the space of the cosmos. There is absolutely no arbitrary line, either mentally or physically, dividing man from the other organized beings sharing with us a home on this earth. As we know that the physical body has been developed from the lowest unicellular organisms up to man, so we believe that the mental life has been slowly unfolded and developed from moner to man, moving forward and upward along with the physical development of the nervous system of the body. It is much easier to trace step by step the evolutionary development of the mind than it is that of the body. There are no "missing links" in mental development as there are in bodily evolution. All the graduations of mind are with us, while to follow the evolution of body we must rely largely on paleontology, going back millions of years into the past seeking for the lost links of the bodily changes.

During the Tertiary age, the physical development of animal life reached its limit in size of body. There were giants in those days. Animals gigantic in bulk swarmed in the waters and roamed through the forests in their search for food. But with their overgrown bodies they could not change with the ever-changing environment, and in their struggle for existence they fell by the wayside and perished. A study of their fossil remains teaches us that they were small in brain, sluggish in movement, and generally plant-eating animals. The brain cavities in the skulls of these animals were remarkable for their diminutive size in comparison to their bulk in body. From their extinction development in size of brain took the place of bodily development, and in this increase of brain capacity was the first possibility of man with his ever-growing mind and intellect. Only within a few years has the study of the brain been systematically followed by specialists, and the increase of our knowledge concerning this organ has kept pace with the wonderful advance of our discoveries in all branches of natural science. The brain specialist can now locate the seat of trouble in the brain by the actions of the patient. Its surface has been nearly all mapped out and the centers of perception by the five senses are clearly known. Now having this knowledge of the physiology of our own brain, when we find in the animals below man precisely the same nervous system with its brain so closely resembling that of man, must we not, if we have any regard for all these wonderful analogies, say that accompanying that animal brain there must be the same kind of mind that we possess? I believe no candid person, not prejudiced by superstition and dogma, can know these facts and then deny that these placental mammals, having nervous systems and brains so similar in every detail to ours, must also possess minds of the same kind as ours, differing only in degree. It is hard for us to avoid comparing the minds of the animals below us with our own, forgetting the vast difference between our mind and that of the lowest races of men now living. There is vastly more difference between the mind of our most cultured and educated man of today and the mind of an Indian, Veddah or Australian Negro than there is between the mind of this lowest human being and that of the ape. There is more difference in the weight of brain in the highest and lowest men than there is between that of the lowest man and the highest primate below man. I believe that no one at present would presume to draw an arbitrary line across this long development of mind and brain and say that on one side of such a line was mind or soul and on the other side absence of the same attributes. In all our human experience we find mind and body indissolubly linked together. Shall we deny the same kind of mind to the same kind of physical apparatus because it is found in the body of the dog, horse, elephant or ape? I can see no just reason for such action on our part.

I have thus far spoken of mind only in connection with those animals possessing a nervous system and brain similar to that found in man. But mind is not by any means absent in those organized beings still lower than the vertebrates. But this part of my subject I must pass over briefly lest my paper should become too long. All organized beings down to the amoeba, that lowest single-celled animal, exhibit traces of mind. They all show the exercise of choice and will. They all respond to stimulus by reflex action. It is quite probable that those animals that do not possess a brain have very little, if any, of what we call consciousness. But in their low and simple life they do not need this higher attribute. It is safe to say that from moner to man every organic being possesses all the mind that is necessary to a full and complete life in the station where it is found. Even in undifferentiated protoplasm, the foundation of all organic life, both vegetable and animal, such as was dredged up from the bottom of the ocean by the British Challenger expedition and named by Huxley *Bathybius Haeckelii*, there was found traces of life and mind. It responded to stimulus by reflex action. Life and mind have their beginnings far lower down toward the inorganic world than most of us know or believe.

In the title at the head of this paper I used the word immortal as connected with mind or soul. In closing I wish to briefly speak of this part of my subject. Immortality, or a life after this earthly life is finished, is justly held to be the most important question confronting civilized man. While we have absolutely no proof to offer in the affirmative of this question, so we have just as little to offer in the negative. It is and must be forever unknown to us while in the body. The finite mind cannot conceive or know the infinite. The mortal can never comprehend the immortal. All our mansions in the sky must be built by faith and planned in imagination will differ as much as do our earthly mansions. In all human religions the ideas of immortality and a life beyond the finite life here are found to be on a level with the mental grade of the people among whom such ideas are held. The personal equation holds in this as in other mental matters. We must all use the tools we possess, manual or mental. The railroad grader could not use the jewelers' tools nor the savage the thoughts of the philosopher. And so the old warlike Scandinavians saw their heaven in Valhalla, where glorious battle was waged during the day and each night the dead and wounded were restored to health to again fight on the succeeding day. The followers of Mohammed, looking up, saw Paradise, peopled by lovely Houris, among whom all the joys and delights of this life should continue through eternity. The Indian looked forward to the Happy Hunting Grounds, where, with his faithful dog and pony, untroubled by the white man, he should spend an eternity in the chase. The Christian sees the new Jerusalem, with its Jasper walls, its pearly gates and streets paved with pure gold, where the faithful shall spend an eternity singing the praises of his God. When the German scientist Moleschott said "no thought without phosphorus," no mind without brain, he was within the bounds of truth as far as our human experience teaches us. But when that other German scientist, Ernest Haeckel, quoting this saying of Moleschott's, says this does away with the dogma of immortality, he may be, and I believe he is, just as far outside the bounds of truth. There may be other modes of existence for mind as far beyond our earthly mind as the most faithful Christian has ever claimed. But this we can only hope for and can never demonstrate its truth or falsity. To my mind we have in evolution our strongest hope of immortality. Evolution is ever a becoming and its work had its beginning in the eternity of the past and can only end in the eternity of the future. Mind as a product of evolution has always existed, and in our world has been growing broader, fuller and more complete as the centuries have come and gone. I cannot believe that when the material part wears out and perishes the mental part, having so much more value, will end also.

I have spoken in the earlier part of this paper of the two theories so closely linked together, the conservation of matter and the conservation of energy. These two theories, one the foundation of the science of physics and the other that of chemistry, are accepted and believed by nearly all educated persons who have thought of them. The matter of the whole vast cosmos is alive with energy flashing from sun to sun. In the future I can see two other theories just as closely bound together as are those of matter and energy. These will be the conservation of life and the conservation of mind. I am aware that this idea was hinted at by Grecian philosophers thousands of years ago. May it not be that these inseparable twins, life and mind, are, as known to us in the whole organic kingdom of this world, as fixed and unchangeable as are the other two, of matter and energy? It will be more difficult for science to demonstrate the truth of these two conservations than it was to explain and show the workings of the theories of matter and energy which are in reach of our science, as their manifestations go on in our world. But the man who fixes a limit to scientific progress in knowledge by man is much more sanguine in his belief than are those who have studied the progress in this direction during the last hundred years.

THE STATE SURVEY OF SOUTH DAKOTA.

BY ELLWOOD C. PERISHO.

At the request of the Editor, I gladly contribute the following concerning the object and work of the South Dokta State Survey:

The Geological and Natural History Survey of this state was established a little over a decade ago. The publications of the survey are three bulletins, issued by the then state geologist—James E. Todd. The entire manuscript, notes and all, of the present state geologist, for Bulletin No. 4, were destroyed in the burning of one of the halls of the State University some months ago. The survey hopes to publish a bulletin during the present year.

The general topics thus far discussed in the publication are as follows:

Bulletin No. 1—A preliminary report on the geology of South Dakota, including chapters on the topography and general geology of the state, along with a discussion of the different eras and ages represented, and something of the economic products.

Bulletin No. 2—This publication treats largely of the geology of the Black Hills and the Bad Lands, along with some other areas. Also a discussion concerning artesian wells.

Bulletin No. 3—The mineral resources of South Dakota, embracing especially the mineral wealth of the Black Hills and non-metalliferous economic products of Eastern South Dakota.

The first consideration of the state survey, in determining the character of its work, would certainly depend upon the object of the survey as set forth in the law, by virtue of which the survey has its existence. While it may be possible, in some states, for the state geologists to place various interpretations upon the exact meaning of the enactment creating a state survey and defining its work; yet in South Dakota no misunderstanding can occur. The law is plain and the objects are clear. In fact the entire fields of geology and natural history are open to its investigations, special mention being made of the minerals, as all ores, along with such non-metallic products as building stone, clays, soils, cements, salt, coals, gas and waters.

Under the investigation of the Flora of the state the legislature asks for work along lines of the grasses, plants, shrubs and trees. This has been done more especially by the men of the Agricultural College. The law also calls for a study of the mammals, birds, reptiles, fishes and insects of the state.

The problem with this survey is not to determine in what field we are expected to work, but just what sort of investigation will be most valuable in consideration of the vast amount which might be done, and the very limited means granted by the legislature for the execution of the same.

What any certain state survey should do is always dependent upon the natural resources of the state and their degree of development. But what a state survey can do is also dependent upon the resources of that survey in men and money.

As a rule, one might be safe in judging that funds are appropriated with the view of the utilitarian development of the resources of the state. No one will question the appropriateness of such an aim. Especially in the new and undeveloped states.

It should be the first duty of the survey to make an exploration of the state in such detail as to discover the important economic products, the use of which would bring to the people of the state either comfort or convenience. This would, at the same time, increase the wealth of the counties and decrease their taxes.

This exploration does not simply mean the discovery of valuable mineral wealth, but an investigation of the ore bodies, the coal seams, the clay beds, the cement deposits, the building stones, the oil fields, the gas belts and the artesian well areas, so that there need not be such a waste of time and money in useless efforts to find these valuable minerals on the one hand, nor upon the other the lack of finding them. In most states, to be sure, the greater part of the resources have already been found, but in many cases much valuable work may yet be done.

This work will be of the nature of determining, with the highest possible degree of accuracy, the manner of occurrence, the geological strata, the distribution and the possible extent of the above named resources, or of any mineral products of economic value.

One thing more should always be in the mind of the survey in determining the real value of any deposit or formation. Is it accessible? Can the people get it without too much cost? Is it plentiful? Or is it in limited quantities? A coal bed may be within a few feet of the surface, yet in an almost inaccessible locality, or it may be near a city, but many hundred feet below the surface. Location should be studied both geologic and geographic.

Gold, or some valuable ore, may be found. A small piece will give a very high value per ton when assayed. This may indicate a wonderfully rich mine, or it may prove, on thorough investigation, in such limited quantities as to be of no real commercial worth. It is the business of a survey not only to find the products, but to determine much more than mere location. The question of the material being successfully utilized by the people is really of more importance.

The above will, of necessity, involve the making of maps and the publication of reports. These should be of such a nature as to be of the greatest possible use to the largest number.

I am very certain that a state survey should come as near to the masses of the people as is possible. This is true from a two-fold reason: it is for the people, and from them it must get its means of support. This nearness may be brought about by the survey discovering the possibility of new and valuable industries; or by sugestions and explorations showing how unprofitable ones may be made to pay; and by giving to the people in published reports such statistics as will show the development and production of the varied enterprises of general interest.

There is another means of bringing the survey near to the people. The publication should be of such a character as to be of real worth to the schools of the state. The educational side of the survey's work may not be considered of the most importance, but it certainly should be of great value. In attempting to carry out the above ideas as to what a state survey should do, it will be the intention in this state to make the survey's work and publication both educational and utilitarian. We shall aim to bring the survey as closely as possible to the schools of the state. We are certain that both teachers and pupils will be interested in seeing a large and valuable collection of the type Fauna and Flora of the state put into a museum, where the animals are all properly mounted, labeled and described, and the plants, including wild-flowers and grasses, are put into a systematic collection, properly classified and named. Such a collection of wild animals and native plants would be of exceptional value to others besides those directly connected with the schools.

As this line of work is for the good of all it will more nearly reach the end for which we strive if the survey can have the hearty co-operation of all who may be interested in such a collection.

Some of the latest field work of the survey, upon which no reports have been published, include the following:

1. The General Geology, Fauna and Flora of the Rosebud area.

2. The study of the Native Grasses of the Plains west of the Missouri River.

3. The General Geology along with the Fauna and Flora of the Missouri River—work not yet completed.

It is the aim of the Survey that all field work, whatever the time or place, will always be of such character that it may be properly correlated. A unity of purpose must run through all field observations.

Among the more important economic problems which the survey expects to investigate at its earliest opportunity, may be mentioned:

1. The mineral Fuels.

No one economic product would add more to the almost universal convenience of the people than a sufficient quantity of cheap local fuel. The survey, in preceding years has done what it could in the investigation of this question, but a more extensive study of the problem might be of inestimable worth. The coal-bearing lands, as to location, extent, thickness of seams, character of the coal or lignite, should be carefully investigated. The same thing is true concerning peat beds and natural gas areas. That both coal and gas exist in South Dakota, is well known, but to just what extent these products can be generally used should now be determined.

2. Clays.

In a region so free from timber and so rapidly increasing in population as is South Dakota, there are few more important economic products than the building materials found in the stone beds and clay deposits. This state is rich in Cretaceous and other residual formations. as well as the clays of glacial origin.

It is well known that we have here extensive beds of many kinds of clay, including not only the common brick and tile clays, but also those good for fire brick. porcelain pottery and fine wares. Our cement making materials are already well known for their excellence. A more careful study of all the above than has yet been possible is not only desirable, but should prove of great material benefit to the people of the state.

3. The water. As yet there has not been a systematic study or investigation of the chemical constituents, from an economic and sanitary view, of the waters

of the state. We believe that it would be of practical value to have the waters carefully examined with reference to the following points:

1. As to the sanitary condition.

2. As to their suitability for boiler uses or for manufacturing purposes.

3. As to their medicinal properties.

This examination would be conducted along the lines of the leading classes of waters of the state, as (1) streams, (2) springs, (3) alkali springs and wells, (4) shallow wells, (5) deep wells, (6) mineral waters, etc.

There is another problem involved in the water of South Dakota doubtless of more value to the people than the topics mentioned above. This is a question of the supply and flow of the artesian wells. In many places throughout the artesian well area the bore of the wells is large and the flow far in excess of the actual water consumption. If the artesian water supply is inexhaustible, no matter how many wells are put down, then it will make no difference as to the size of the bore or the amount of water allowed to flow. Such a hypothesis, however, one can scarcely entertain. The question of the flow of these wells should be studied through a long enough period of time to determine whether the wells will keep a uniform pressure and output under the same general conditions. Also to ascertain the influence upon existing wells when new ones are bored in the same immediate locality. The whole problem is one that should receive immediate attention. The state can ill afford to waste its valuable water supply. South Dakota is rich in her economic resources both in her ores and the non-metalliferous deposits. She has a great variety of Fauna and Flora. No state can surpass her in the extent and interest of her Fossil beds, where the skeletons of many species of large extinct mammals may be found. To bring a practical knowledge of all these to the people of the state is the aim of the South Dakota State Survey.

RESULT OF THE INVESTIGATION OF THE INDIAN MOUND AT BROKEN KETTLE CREEK.

BY W. T. STAFFORD.

Primitive man was not a nomad, at least not in the common application of the term. He did not wander far from his usual haunts. The reason suggests itself upon little reflection. Man, out of necessity, must have existed first in the warmer climates and was confined to the locality that would furnish him food, water and shelter from the sun and rain. Not until he began to make water jugs and grain sacks out of skins of wild animals did he undertake long journeys. The subject of transportation, then as now, was one of the problems confronting man, only in different form, but until he could carry food from place to place his migrations were limited. Undoubtedly, when food and wood became scarce in one locality, they moved to a more convenient camp, but it was only a little further along the same stream or lake. When pots and jugs and bags were made, then began the movements to the colder zones, accompanied by the manufacture of clothing and the domestication of animals.

About the first thing primitive man did was to fashion himself a weapon for the purpose of taking some of the wild animals for food, and to defend himself from becoming food for some of them, and it would not be unreasonable to say that he made his war club and hatchet before his millstones and mortars, his arrow and knife before his needle, a wampum or his pottery. As they drifted further and further north, they were obliged to build shelter, and provide clothing that would protect all parts of the body. Necessity, not modesty, fashioned their clothes. Out of this necessity grew a custom. Long continued custom made habits which finally grew into religion and superstition.

Another thing that should be said to disabuse your minds of a common fallacy, is that the Indian had few tools and weapons and he put to every possible use such as he had. He did not have a different tool for every kind of work, but made his larger arrows serve as spear heads and knives; his bone needles as drills, awls, punches, etc. Being lazy, it was easier to adapt the tools they had to as many uses as possible than to make new ones, their weight also made them a factor in transportation from place to place. Broken implements unfit for their original use were made over for some other purpose.

The mound investigated is situated on the banks of a spring-fed creek now known as the Broken Kettle creek, which empties into the Big Sioux River about twelve miles northwest of Sioux City and in the southwest corner of Plymouth County.

The mound is up creek about three-quarters of a mile from its mouth in a valley running northeast and southwest. The creek where it passes the mound flows directly west, coming from the north as it reaches the eastern extremity. It would be difficult to find a more sheltered spot in the entire valley. The long row of clay hills that bound the valley on the north and west, rising to a height of several hundred feet, affords at once a shelter from the northwest wind and a screen from the enemy.

The location is ideal for a village. The Sioux Valley could be watched for miles in both directions from the hills, which at the same time provided good ground for defense. The village was far enough from the Sioux River to be undiscovered by the roving bands of the enemy that constantly wandered up and down to the Missouri and the south.

About two hundred feet south and west of the site the creek doubles back for about one-half of the length of the mound. At this point the banks of the creek are heavily lined with trees and underbrush; the village must have been almost hidden from view. This seclusion is one of the reasons for building here instead of on the Big Sioux River.

The origin of the mound is in dispute, one contention being that this pile was the adobe huts that have fallen to ruin and decay, and that on the site there have been successive villages; the other, that the village was near this spot and this mound was that part of their civilization that is now represented by our modern city dump, the rubbish being at times covered with clean, fresh dirt. Still another, and perhaps the correct, theory is that these people camped here year after year and each time covered the debris with a fresh layer of clean clay. This last theory seems to be the more plausible for reasons that will appear hereafter.

There is nothing now to indicate to a casual observer that this knoll was at one time the habitation of a forgotten people. The many years of rain and snow, the alternate seasons of frost and sunshine, have removed all trace of human work, and there is left only a hillock such as we might expect the creek to deposit in its wanderings through the valley, or left by nature when the earth's surface received the finishing touch.

But this oblong mound contains much that will interest the student of anthropology or the seeker after the curious, and the contents tell a tale that contrasts greatly with the life of the modern Red man in this vicinity.

There is no way now to determine the plan of the village. The mound is oblong and is 350 feet long and 115 feet wide in the widest place. The high perpendicular bank on the creek side is due to the spring freshets, at which time the water rises to a height of seven or eight feet on that side of the mound.

The height of the mound is nine feet three inches from the original soil and fourteen feet six inches from the creek bed at the highest point. It is nearly flat on top, sloping to the south and west.

A cross section was dug for the purpose of ascertaining the composition of the mound. This section was four and one-half feet wide, and from the highest point to the original soil nine feet three inches.

This gives a good idea of the structure of the whole, as subsequent investigations revealed the same formation with small variation in other portions of the mound. Beginning about nine inches from the top soil there are alternate layers of clay, sand, charcoal, black soil, bones and other refuse. The layers vary greatly, from a mere trace to a foot in thickness. The charcoal layers are not continuous across the mound, but are in patches. In this section nine patches of charcoal were found in a perpendicular line, indicating that they were thrown there from some fire used elsewhere. In nearly all these patches of charcoal, or near them, are to be found bones of all kinds and sizes, from the small birds to the large deer and buffalo. There is also a large quantity of fresh water clam shells, many of which have marks indicating that they have been in the fire. The greater bulk of the mound is composed of clay taken from the neighboring hills.

All the tools, pottery and implements here described were found solidly imbedded in the clay or charcoal. Since the mound has been deserted by the builders, elm trees measuring four feet in circumference have grown out of the mound. This, together with the absence of all skins and parts of their tools and weapons, which were necessarily made of wood, is an indication of the length of time that has elapsed since the mound was inhabited.

Of tools and implements there seems to be no end. They appear to be more numerous than the weapons and instruments of war.

If these Indians lived like their modern descendants, the female portion of the tribe was permitted to perform most of the labor that pertained to the camp and village life.

A stretch of the imagination might picture the fair hand of some romantic Indian maiden using these bone needles sewing skins for her father or lover on the warpath against the hostile neighbors. It is to be feared, however, that such was not the case.

Bone was the principal article used in the manufacture of these tools and implements. Some, however, were made of stone and horn. The stone for the most part was used for the war and hunting weapons, the bone and horn for the domestic implements and for ornaments. Bone, being the more easily worked, was the great factor in this domestic economy.

The articles of stone consist of gristmills, for grinding corn, smaller ones for grinding herbs and roots; stone axes, needles, war clubs, arrow heads, spear heads and other instruments.

The axes are made after the fashion of those with which we are familiar. The war clubs are of different sizes. They are usually of the common boulder.

The arrow heads are of many sizes and kinds, ranging in length from one-half inch to four and three-quarters inches, with all the intermediate sizes.

Bone needles are the most numerous of all the tools and implements to be found. There seems to be no special shape or size to them. All are ground down to a fine, sharp point. The difference in length may be accounted for in some measure, at least, by the method that was used in keeping the tools sharp. When they became dull, by use or otherwise, they were rubbed on the surface of a soft sandstone until they were again sharp. In this manner they grew shorter with each operation. This continual grinding on the sandstone caused grooves to be formed in the stone.

The bones used in the manufacture of the needles were from various birds and small animals. As will be surmised, the method of use of these needles differed somewhat from that of our modern steel ones. When the Indian woman of long ago wanted to sew, she punched holes with her needle in the skin or leather and drew a strip of string or rawhide through, repeating the operation on both sides of the articles to be sewed until the job was completed.

A few feet down a pair of instruments was found which was used to take the fish from the rivers and lakes. These fish hooks are of solid bone and are shaped like the modern steel hook with the exception of the barb, which is missing from them. A small knob was left on the end for the purpose of fastening on a thong or strip of buckskin.

Common stone and bone scrapers used for the purpose of scraping hides and for marking pottery, and another tool for marking pottery was a bone instrument with notches in the end, so made that in drawing it once across the soft clay several lines were made.

The art of making pottery was the crowning feature of this civilization, if the word civilization may be used in this connection. The ability to make dishes and pots for cooking was a long stride in the direction of domestic qualities, wherein the red man is usually deficient. Many and various are the pots and dishes to be found in broken fragments in the mound. In all probability the discovery of this art was about the same as that of the southern Indians. The first vessels were made of wicker or straw and grass. Clay was then plastered onto the outside to protect them from the fire. The savages soon noticed that after the wicker had burned away the clay would harden and remain upright and could be handled. Experiments were made and soon it was demonstrated that pots and kettles could be made without the aid of reeds or grass.

Their most finished article was a crude affair as compared with the fine china of our times, and there must have been unnumbered dishes of all kinds, as it is impossible to dig to the depth of one foot without uncovering several pieces of different dishes. A large portion of these are decorated. Some of them are reddish brown, most of them black. A few specimens of light gray are to be found, but these are rare. The decorations consist of intersecting straight lines forming different designs. There are very few curved lines, and these are crude and uneven. Some of them are ornamented with fancy rims, which served the purposes of decoration and lifting. Some were graced with ears of various kinds and designs, usually worked into the head of some bird or animal. The examination of this mound disclosed thirty different decorations, some of them on the body of the vessel, others on the rim and a few on the neck and shoulder.

The investigations during the past few years have been disappointing in that no complete pot has been found. The best that can be shown is the major portion of a small pot found eight feet under the surface. Careful search for the remainder was futile.

Some of these pots were made exclusively for carrying purposes, as they had round bottoms. These were made with a slight bulge just above the neck between it and the rim. There were three ears on these rims, through which a cord was passed entirely around the pot to be used as a bail. They were always carried or hung, and were used for cooking over the fire. The remains indicate that this class of dish was a very common article.

The pottery in this mound does not show the individualism of the makers, as do the flint and stone instruments. It may be that the art of pot-making was confined to a few, or that the same method was used by all who took part in its manufacture. There are, of course, many kinds, and hardly two alike in texture or thickness; yet there is a great similarity in all of them.

Among the pottery ruins were discovered several flat coin-shaped pieces of clay of the same make, as far as appearances go, as the pots. They are from an inch to two and three-quarters inches in diameter, perfectly round and smooth on both sides. One of them is slightly concave. One of the smaller is colored a light red on one side.

Some of the southern tribes, as stated by some of the authorities, used disks of this kind as wampum and a medium of exchange, but this is doubtful, owing to the brittleness of the clay and the ease with which they could be manufactured. The more probable use was for decorative purposes, ceremonial or playthings.

The decorations on these pots were the forerunner and beginning of an art culminating in the Venus de Medici. Our present civilization passed through the crude stages and conditions as are revealed in the mound. The rough and uneven decoration is the great grandmother of all that is beautiful in painting or sculpture. The one reason over and above all others why we should study these things, is that we see in these people our own beginning, the start and infancy of our own wonderful civilization being re-enacted before our eyes. The story of the American red men of yesterday is the story of the white race centuries ago.

Flint implements and weapons have been described. The chief reason for the selection of flint in the manufacture of articles was the hardness, the lightness and the edge that could be had, making it the most desirable for cutting purposes and for arrow and spear heads. The Aborigine used flint for cutting purposes where we now use iron and steel. The flint drills were used in the same manner as the bone ones, though vastly different in shape.

Among the finds in flint were some minute arrow heads, most of which are perfect. Some of the authorities call them bird points, but observation and reason would lead to another conclusion. For example, some of them are too small to admit of their being fastened to any shaft. Again, a practice among the tribe was to shoot the birds with blunt arrows, in order that the blood might not discolor the plumage, which they desired to to wear. For the larger birds, used for food, the ordinary arrow was used. Small arrows were used for war purposes, and when so used were poisoned, but they were larger than these small points. Among some of the tribes it has been recorded that these small arrows, being strung together, were used to designate the different chiefs and honors; the greater the chief, or warrior, the more points. We pass the theory that they were used as playthings for the children with no further comment than to refer to the indisposition of the red man to perform unnecessary labor of any kind.

Different sized arrows were no doubt made for different kinds of shooting, the shape, weight and size of the head having much to do with the penetration, speed and trajectory of the arrow. This would necessitate the owner of a quiver full of flint-pointed arrows, all of different sizes and weight, to be familiar with each and every one of them, to know which ones would shoot high and which low, the same as a sportsman knows his rifle.

One of the most interesting phases of this wild life is found in the ornaments, the most popular being the shell beads, because they were bright and beautiful, and were compartively rare, being hard to manufacture. They are interesting because they are the beginning of the beautiful work of gold and gems that now adorn our ladies. The wearing of diamonds and other precious stones as ornaments may be traced back to the half wild white man in Europe. The Indian found the shells in the creek and the Big Sioux River. They had their drills and other tools, but the shell was brittle and hard to work, hence its rarity and value. The beads found in the mound are much different from those found in any other portion of the state. Out of a string of nearly 100 beads from the state museum sent by Mr. T. Van Hyning, nothing like these are shown. Some of the reports state that the same kind have been found in Tennessee and Colorado and probably at places between these states. They vary from one-fourth of an inch to one and one-fourth inches in diameter, perforated in the center. Some of them are perfectly flat on both sides, some are concave and some are convo-convex and others double convex. The circumference is smooth and round, the circle being almost perfect. The perforations vary slightly in size, according to the size of the bead. Some of these beads have been painted and still retain some of the traces of the paint, but most of them are the natural color. Some of them show evidences of having been burned, but this may have been accidental.

There are other shell articles that were evidently used as ornaments, one of which is a peculiar shape, being a trifle larger in circumference than an ordinary match with a spiral groove running down, perforated at one end, used to string as a pendant. Other portions of the shell were perforated and strung. They were all white except those that were painted. The small flat beads were the ones used for wampum; the larger and oblong and the pendants for decorative purposes.

In the entire investigations of the mound at Broken Kettle not one article of iron or steel, not one glass bead or copper trinket, sold and traded to the Indian in the early history of America, has been found. This is important, for it tells us that these people were living and building this mound before the white man settled or even traded in this community. And when we remember that the French and English traders and trappers were all over this section of the country in the middle of the sixteenth century, it gives us an idea of the time when these articles were used.

One of the most interesting and suggestive finds in the mound is a salt water shell. As we are almost in the center of the continent, it would be interesting to know where the shell was obtained, whether by a long journey of some of the tribes or, the more probable way, by trading with some wandering tribes that hunted and fished over the entire continent.

These people made the most of nature; that is, they took advantage, as far as their intellect would allow, of the natural formation of rock and flint. The water worn pebble, somewhat of the shape desired, was the one used for tools and weapons.

For battering and pounding they used the harder rock on the softer; for grinding, the softer lime and sandstones; and for bone needles and arrow shaft polishing, the very softest stone that could be obtained. We are at a loss to know the use of many of these instruments, but when it is remembered that there were numerous games, rites, ceremonials, etc., now extinct, which may have claimed the articles as part of them, we unhesitatingly place them in this classification.

Four prime colors have been discovered—red, yellow, white and black. The white, red and yellow were made by burning different kinds of colored rocks in the fire until they disintegarted. They were then placed in a stone mortar and ground until they were pulverized into a very fine powder. This powder was mixed with animal grease and this mixture was used to paint their faces, feathers, skins, etc. This would soon wear off, leaving the article painted the original color, but the Indian soon learned to boil his paints, and the color would remain permanent.

Black was made from charcoal and lampblack gathered from the pots and kettles. A little experimenting along this line will demonstrate the correctness of these statements. In coloring pots the colors were sometimes mixed with sand in such quantities that it would color the sand, and this mixture was rubbed into the pot before it was burned. A quantity of this mixture was discovered with the remains of a pot, which might have contained it all ready for the potter's use.

An explanation of the terms "pecking," "chipping," "battering" and "flaking" would be in order at this point.

By "pecking" is meant that style of work in which one stone is pecked with another having a sharp point or edge. This operation leaves the surface rough and full of minute depressions.

"Chipping" is the term applied to the manufacture of flint weapons and tools, and is done with a bone or stick hardened in the fire.

"Flaking" is also used in connection with flint, and consists in taking off flakes of flint in giving shape to the instrument, like chipping, only on a larger scale. It is done with a flaking hammer elsewhere explained.

"Battering," as the word implies, is the smashing of one stone against another until the desired shape is secured. It is used in the manufacture of hammers, mauls, net sinkers, etc., and for all implements that do not require a smooth or even finish.

From the many different types we are led to believe that all made their own tools and weapons to suit their individual taste. While they are made in the same general manner and of the same kind of material, yet there is always a difference, more than there would be with the same tools of the same material with the same workman.

The more industrious would put a smooth finish and a polish on their instruments, while the indolent would be satisfied with the pecked or battered condition, leaving the work rough and uneven.

The groove in the pecked hammers and mauls is made by pecking entirely around the hammer. The groove and body are left rough and uneven. We call them "hammers," but they had many other uses. Among the more important was the grinding of corn, which was done in the following manner: A good sized boulder with a depression, either natural or artificial, was secured and placed under the limb of a tree. A rope of deer hide was fastened to this limb and to the rope at the correct height so that it would be a few inches above the boulder the hammer was fastened by its groove. The corn or roots to be ground were placed in the boulder and the operator taking the hammer in his right hand would bring it down on the corn with a slight rotary motion, the limb of the tree assisting in the work. When a tree was not convenient, then one of the long poles used for building the tepee was pressed into service. Without doubt there were many other uses for this instrument of which we do not know.

The hand hammer was a very different thing from the one just described, and is what is known as a "flaking hammer." There are many sizes, depending upon the size of the original stone, strength and skill of the user, and the purposes for which they were intended to be used. The larger ones are called "battering hammers" by some of the archeologists. The larger ones are pecked rough; the smaller ones are rubbed and polished. Three have been taken from this mound. The smaller one is one and three-fourths inches in diameter and six inches in circumference, weighing two and one-half ounces. It was used for flaking and large chipping and is highly polished. Another is two and three-fourths inches in diameter, eight inches in circumference, is much thicker and unpolished, and weighs eight ounces. The largest one is four inches in diameter and eleven and three-fourths inches in circumference, is over three inches thick and weighs twenty-four ounces. All these hammers are made in the same manner. Their circumference is circular and there is a slight depression in the center of each side to keep the hammer from slipping out of the fingers. They are used in the following manner: The thumb and second finger are placed in the depressions on either side, the first finger on the top to prevent slipping, and the blow is struck with the wrist, the fingers simply guiding the hammer and remaining loose in the depressions and not holding the hammer tightly. To have the fingers tight and the wrist stiff would in a few minutes render the arm useless and would paralyze the hand and wrist.

In the manner stated rapid blows could be struck effectively and with precision without injury to the arm. It might be added that these hammers have been found in all parts of the world. They are found among the comparatively modern Indians and in the ruins of ancient Troy, fifty feet below the surface. It seems to have been the universal tool of the uncivilized man.

Battering one stone against another was, of course, the very earliest discovery of the savage. In cracking nuts gathered in the primal forests, and grinding herbs and bark, the primitive man did what the small boy does today, lays the object on one stone and crushes it with another.

This "battered" tool is without doubt the oldest form of tool making. It came before man learned to "peck," "chip" or "flake." Its usefulness made it permanent until it was supplanted with steel and iron of the later civilization. It was a powerful tool and weapon in the hands of an expert. Used with the hammer and closely resembling it was the ax, several of which have been taken from the mound. They are made out of different material and are different in shape. They are usually pecked instruments rubbed down and polished. Unlike the hammer, the groove is around the sides and one end, the other end being smooth. The grooved end was always away from the handle. The bitt or cutting edge is worked down from both sides so that the edge would be in the center of the instrument. The bitt close to the handle is lower than that part further away. This is to give it more power in felling trees and the other work for which it is designed. It would be interesting to know how the discovery of many of these little points was made, but it is impossible. Some of the axes have their groove on an angle so that in fixing on the handle the bitt would be thrown much closer to the handle than fixing it at right angles; this, too, is for the better working of the tool. The poles of these axes show that they have been used for hammers.

Among the stone finds is a pecked stone, oblong, with the ends flattened by pecking and battering, used for polishing and grinding, and might have been sewn into a skin and used as the modern policeman uses his slungshot.

There are celts of many shapes and sizes. Some of the instruments so called are no doubt agricultural implements and tools for various purposes, but not knowing what else to call them the archeologists have called them "celts." Some of them are pecked and unpolished. The others are rubbed and polished to a high degree. The latter were used in the hand, while the rough ones had handles. This is why the rough ones are thought to be used for other purposes than what the celt was used for. A peculiarity of the ones found is that they are made in two different forms; that is, one form where the blade has been worked down from both sides, as in the ax, while the other is worked down from one side, leaving the blade on the other side. This latter style was fastened at the proper angle on a strong stick and used as the modern carpenter uses his plane, only that the plane in this case was usually stationary.

It should be remarked here that it is difficult to distinguish where the celt leaves off and some of the other tools and implements begin, such as the spade, hoe, scrapers and many other instruments that the original use of which was intended for something else. Then again, a notch or groove would change altogether the character of the instrument, and that which was a celt or a scraper would become an altogether different tool. Some of the finds are of incomplete instruments, and we may only guess what they might have been in their finished state. Celts were used for many purposes and in many ways. The principal use to which they were put, was the skinning of animals and the preparation of the skins for tanning. They could be used as wedges in splitting logs, and they could be set in a handle and used as a light ax, war hatchet, spade, hoe, etc.

The use of bone for domestic tools and implements has been very general among the American Indians at all times. They are found in their oldest remains and are used at the present. Being easily worked, it was especially adapted for the purposes for which they were intended, requiring very little labor to make them serviceable.

The bone implements, tools and miscellaneous instruments taken from this mound during the past summer amount to over two hundred, consisting of needles, awls, fish hooks, scrapers, drills, flint scrapers, rattles, whistles, etc. There are three kinds of needles, the flat, the round and the half-round. The latter ones are made by splitting the round ones. The round and the half-round ones are hollow, while the flat ones are solid. There could be no regular size or shape for these needles, as their fashion would depend upon the size and shape of the original bone, the industry of the maker and the use for which they were intended. The round needles, or, as they might be more properly designated, "punches," were found upon experiment to make a much larger and better hole for the purpose of drawing rawhide through than the flat ones, and were evidently used where heavier work was to be performed, such as sewing tepee covers, robes, etc. The points of these punches are on one side of the instrument, they being as round as the original bone down to where it begins to taper to the point. In the flat needles and awls the point is in the center, being worked down from both sides like the point of a paper knife. Those of the half round variety are pointed like the full round. In point of number the flat ones are more numerous, the semi-round next and the round ones the rarest.

These instruments are the ancestors of the modern steel needle, and from these crude bone tools our civilization has evolved the modern one used in making the fine laces and building the beautiful fabrics so common to us. These bone tools were once used by our ancestors. In many instances these needles show signs of having been tempered in the fire. This made the bone hard, but very brittle, and required an expert operator to keep it from snapping into pieces when being used. There was another method of dealing with the bone to make it serviceable (and a much better one, although it took longer in preparation), and that was to bury the bone in a bed of wood ashes and leave it until the animal matter and the fat and grease were entirely out of it. This method seems to have toughened it, but not hardened it. This method was used in the preparation of bone for arrow chipping and flaking, as it would render the bone tough, and at the same time, the grease being out, it would not slip.

The larger needles may have been used as daggers and sticking knives. They are easily fitted into a deer prong, made hollow, and would be a very serviceable weapon. The smaller ones may have been used as arrow and spear points when flint was scarce.

Next to the needle in importance comes the drill, used for innumerable purposes in the manufacture of other tools, ornaments and weapons. They were of both flint and bone. The bone drills were of two kinds, one of which is round its entire length, the other with round point, but with a square base. These were no doubt used as needles and could be fitted into a handle and used as awls and punches. One with a square base was discovered during the summer, and several of the round ones. The method of use of these drills was the same, with the exception that the square base was fitted into a round stock, and the string of the drill used on the stick instead of on the bone.

These drills were used in the following manner: A bone drill was prepared and hardened and fitted into a stick not over two inches in diameter and long enough to reach from the top of the drill when it was in position to the operator's chin, he being seated. A bow arrangement about fifteen or eighteen inches in length with a cord which was circled several times around the drill was fastened to each end of the bow. The operator taking the bow in his left hand, guiding and directing the drill with his right, using his chin to give the necessary pressure, would draw the bow back and forth, giving the drill a rapid rotary motion. In this manner holes were bored in shell, pottery, bone, wood, and even in stone. An expert with the tool was able to drill through some of the hardest rocks. The friction of the string on the bone during this operation would sometimes cause a depression to be worn around the drill, making it weak at that point. This is noticeable in one of the drills found. To avoid this, the round and square drills were sometimes set in wood deep enough so that the cord would wear the wood instead of the bone, which could be more easily replaced. A square base was better, because a round drill in a round holder would be liable to slip, while a square one could be wedged tight. The drills were all worked to a uniform size throughout the instrument, while in the awls and needles it usually continued in the shape of the original bone to the point.

One-half mile due east of the mound, on the summit of a sharp hill that rises abruptly from the creek valley and overlooking the Big Sioux valley for miles in all directions, is a burial place or graveyard that was used by the people who inhabited the mound. The entire top of this bluff is thickly strewn with remains.

There seems to have been no particular design for the cemetery, or any regularity in these burials. On the contrary, there is evidence that many were placed one upon another. To illustrate, within a space of three feet square were found the remains of six different persons, apparently buried one over the other, yet so close to each other that the taking of one would in many instances reveal the other. Two skulls taken from the spot were so close that it was impossible to remove one without the other. One was a well matured adult, the other a very young person. Directly beneath these were the jaw bones and parts of several others in a very advanced stage of decay. The arm bones of at least six different persons, together with the ribs and leg bones, were scattered around these skulls.

From the various positions and directions that these bones are in it is evident that they were placed there without any regard to the former burials. No weapons are found in these graves, nor ornaments of any description, with the exception of a very few beads. These were not found in the graves, but on the side of the hill.

The burial hill gives evidence of having been several feet higher than it is at present, and it may be that these remains were buried much deeper than they are now found.

Those near the surface have been reached by the frost and moisture and are in a very advanced state of decay. Those that are deeper are better preserved, while those that are the deepest are so old that they crumble to dust upon being exposed to the air.

From the positions of these bones in their graves it would seem that they were placed there after the flesh had been removed, as it would be impossible to place the human form in the positions that some of these remains are found. It is possible that these Indians, like others in this vicinity, hung their dead in trees and on scaffolds until the flesh had been removed by the Great Spirit; or, as the white man calls it, Nature. Then the bones would be gathered and dumped wholesale into a trench or grave dug for that purpose.

The absence of weapons would seem to support this theory. They were placed with the dead for the purpose of use in the "Happy Hunting Ground" and for the spirit to use to protect the flesh from the wild beasts until it had been gathered to the Great Spirit. After that they were no longer needed, as the flesh did not need protection, and as there was no longer any necessity to obtain food to satisfy the flesh weapons were not a part of this final interment.

There are several other burial hills in this vicinity, but the time did not permit the investigation of them.

Thus lived and died those inhabitants of the Broken Kettle country.

PREHISTORIC SKULLS.

BY GRANT J. ROSS.

Unfortunately for mankind the history of the race still remains submerged in obscurity.

Not only ancient historians have made attempts at historical verification of man's origin, but numerous conscientious and painstaking investigators in different parts of the world, and at various periods of recent historical eras, have faithfully labored for years endeavoring to solve this problem; yet there is no consensus of opinion as to the absolute facts of the genesis of man. In a brochure of this scope and character it would be distinctly inappropriate to indulge in any lengthy speculation upon the various theories which have been accorded more or less prominence by various ethnologists; and a rehearsal of theoretical propositions would not materially contribute to the elucidation of the subject of this paper.

In view of the general anatomical similarity of structure of all of the vertebrata, man's origin from a lower form of animal life requires no special emphasis in this brochure; the theory has more than enough to recommend its general acceptance, yet in the absence of any fossil remains of the necessary missing link or intermediate anatomical connection, in the light of our present knowledge, it is entirely insusceptible of adequate demonstration.

It is an established fact, however, that during tertiary times all animal organisms were constructed upon a gigantic scale.

Wherever fossil remains are found in tertiary deposits gigantism characterizes the race, and we are satisfied that man, at the present time, bears the earmarks of his gigantic ancestors.

Some thirty years since, Prof. Marsh discovered fossil remains of a small horselike animal, not larger than the fox, in the tertiary beds in Wyoming, and at once proclaimed this extinct animal the progenitor of the horse, notwithstanding that all other vertebrates were preceded by gigantic ancestors. It was left to the author of this brochure to correct this error and place this servant and companion of man in the same relations as other animal organisms as to gigantic ancestral heritage.

Some eight years since, while searching in the outcropping of the tertiary beds that are found along the Big Sioux just south of the Talbot farm, nine teeth of the extinct horse were found in the sand pits which abound in this territory. These teeth were about three times the size of those of the horse as he is now known. Specimens of which can be seen in the museum of the Academy of Science and Letters of this city; also in the Smithsonian Institute at Washington, D. C.

This gigantic ancestral horse we named Hippus Giganticus. Many other fossilized teeth of the same gigantic animal have been found in Wyoming tertiary beds by parties sent out by Yale and Harvard during the last year, and a gigantic parentage of the horse has been fully established.

It is the law of natural selection to establish a fixedness of type, and only environmental influences change this type and cause variation sufficient to produce a type of sub-species. Hence from giantism to dwarfism is the rule when suitable alimentation is scarce. This rule has held good all through the ages, and only when selection has been guided by the human intelligence has there been any tendency to return to the original dimensions.

Believing then, that giantism was the primitive physical condition of our race, and that pigmy races are the mere physical degenerates of gigantic parentage, we are prepared to discuss some characteristics of this race of dwarfs.

While grading a public road near Climbing Hill, in Woodbury county, about two years ago, there were exhumed parts of three skeletons of a race which seems anamolous and out of joint with characteristics of the environary races or the then inhabiting people. We refer to the North American Indians, who were and are a round-headed or bracheocephalic race, with a facial angle almost a right angle.

The skulls here exhumed belonged to a long-headed or dolichocephalic race of dwarfs. The three skulls are identical in the plan of construction and were similar to a mycrocepshalic (or a person with an undeveloped cerebrum), being about the dimensions of that of a child of six or seven years of the negro race. That these skulls were those of adult persons was proven by the complete ossification of the cranial sutures, as well as the thickness of the cranial bones, which are much thicker than those of an adult of the white race.

These skulls are boat-shaped or compressed, as it were, laterally, the frontal bone being about one-third narrower than the occipital bone. We are certain that these skulls were not flattened latterly by mechanical means, for the reason that the Indian tribe known as Flatheads, now inhabitants of the state of Montana, compress the head ante-posteriorly and not laterally, which causes the head to resemble a cone or sugar-loaf appearance.

The long bones found of these skeletons were only fragmentary, but sufficient number of the fragments were secured to demonstrate the fact that these people were not over four feet tall. The cranium, after being built up with the fragments, is nearly complete in its superior aspect, but the face, upper and lower jaws and under surface of the head are entirely wanting. No teeth were found or at least saved by those who exhumed the skeletons.

It is not known that there ever was a pigmy race in North America, or at least there exists no legends among any of the aboriginal races to this effect. Wherever a pigmy people are found there is such a correspondence in anatomical makeup as to identify them as belonging to one race. They are all dolichocephalic or long-headed. The negroids, a pigmy race found in Africa; the negritoes found in Luzon, Philippine Islands, and the Ainoes found in Japan undoubtedly belong to the same dwarf family.

During the World's Exposition in St. Louis two years ago we had the pleasure of comparing the pigmies of Africa with those of the Philippines. The four pigmies brought over from Africa by Dr. Thompson and those from the Philippines were stood in a group, and only for a shade difference in color they were exactly alike. Both specimens were dolichocephalic, had coxigial elongations, had woolly hair, had prehensile toes, were of the same stature and weighed approximately, yet their habitats were four thousand miles apart. How and when this race became separated we cannot tell.

We saw several years ago two specimens of the Japanese dwarfs. They also were dolichocephalic and had coxigial elongations to a greater extent than either of the other tribes. In fact, we might say they had real tails; their hair was silky and wavy and covered almost all of their bodies; they also had prehensile toes, their color was the same as the groups from the Philippines and their weight and stature were about the same. All types of negroes, all brown races, including Arabs, Syrians, Egyptians; all Malays, including the Moros of the Philippine group of islands and Australians, are dolichocephalic or long-headed people. The Mongolos, the Chinese, Japanese, all American Indians, including the Esquimaux, Caribs and all North American tribes, are bracheocephalic or round-headed people.

Now to what race did these people whose skeletons were found in Woodbury county, Iowa, belong? They were not captive negro children, because their cranial bones show that they were not only adults, but were people of some maturer age, and there was no dwarf negro race indigenous to this climate nor country. Surely they were not of the Indian tribes of the Missouri Valley, for there is no dwarf race of Indians known to history. They were not white captives, for the reason that there are, nor never has been, a race of white dwarfs.

It is idle to speculate upon the geographical habitat of these finds, or to do the same regarding primitive man. This find was upon the highroad, which was traveled by many Indian tribes journeying up and down the

Missouri river, which we know was frequently from the mountainous localities in Tennessee and Kentucky clear up to the headwaters of the Missouri. Yet what signifies these opportunities for intermingling of diverse tribes of Indians, where as far as can be ascertained there were no pigmy tribe or tribes from which prisoners could have been secured?

Then, again, these skeletons were exhumed from a soil that was almost inaccessible to water or even moisture, and were to all appearances from five to eight hundred years old. All organic matter had long since been removed by contact with the ground, and nothing but the lime remaining; so we think that the precise classification of these finds is with the group of the negroid pigmies regardless of how they came to be found in a country inaccessible to tribes as we now find them, and are anamolies to the surroundings by a bracheocephalic or round-headed Indian people.

SOME DEFECTS IN MUNICIPAL GOVERNMENT.

BY EDWIN J. STASON.

Good municipal government is a problem in economy and efficiency in the administration of municipal affairs. Men of intelligence and experience are wont to look upon the administration of the American city as an utter failure. For this failure various reasons are given. Speaking generally, the reasons assigned may be included in two classes. First, those which have for their foundation the absence of an adequate realization of the responsibilities of citizenship; and, second, the evils resulting from the enactment of laws by our legislatures without an adequate knowledge of the proper relation which should exist between the public at large, represented by the state, and the local public, represented by the municipality. A lack of civic consciousness leading to a want of interest in municipal affairs, and the bane of unnecessary legislative interference, are chargeable with the large majority, if not all, the ills endured on account of the extravagant and inefficient administration of our cities; and Iowa cities are by no means free from the defects and the shortcomings necessarily incident to the common causes of failure above referred to.

I believe that business men would be much less neglectful of municipal affairs if the form of municipal government provided for our cities were different—if some of its glaring defects were removed, and more scientific, practical and businesslike methods were afforded the citizen by which he could, through his local representatives, remedy and improve local conditions. In other words, I believe that the want of a proper realization of civic duty leading to active participation in municipal affairs is due to the fact that our state legislature has not given us the most practical form of municipal government—a form of government by which the best results can be attained.

The more important defects in municipal government in Iowa having for their foundation either too much or too little legislation are the following, and it is to these defects in particular that I desire to call attention:

1. Under the law as it exists today, too little latitude is given in Iowa for municipal home rule, and entirely too much is arrogated to itself by the legislature.

2. Our mayors should have greater powers and added duties. They should be in fact, as well as name, the chief administrative officers of our cities, and the city council should not be permitted, to the least extent, to share any of the administrative functions belonging to the executive department. All subordinate administrative officers should be appointed by the mayor without even the approval of the council.

3. The duties of the city council should be made purely and distinctly legislative. It should have no administrative authority or power whatsoever, and all councilmen should be elected at large, or at least from large districts, and never from wards.

4. Government by boards and commissions should be entirely abolished, because of the fact that there is little, if any, disposition on their part to co-operate with either the legislative or the executive department of the city government, and in place of the board and commission there should be substituted an individual administrative head of department.

5. A rational corporate debt limit should be adopted instead of the present irrational one. While there should be a general debt incurring limitation, it should not be made to apply to debts incurred to purchase or improve revenue-producing municipal utilities.

I.

The subject of municipal home rule is one deserving of serious consideration and one which must receive such consideration, and be given practical effect, if we would further the best interests of the larger Iowa cities. Whether this can be realized to its fullest extent may be doubtful in view of the fact that unfortunately we are furnished our laws by a legislature which is very largely dominated by "granger" influences, with the result that we have numerous provisions enacted without a correct conception of the proper sphere of legislative action in relation to cities having large commercial interests.

Our present statute classifies municipal corporations into villages, towns and cities of the first and second class, and every municipal corporation, with the exception of the few special charter cities, are subjected to the particular provisions enacted by the legislature for the whole of the particular class. There are four standards of measurement and four classes of rules of conduct. If a city happens to be too large for the measure, excepting in mere numbers, the legislative foot crowds it into it; if it happens to be too small, otherwise than as to numbers, the void is not regarded as a matter of moment; if the rules of conduct are not suited to the city falling within the particular numerical measure, it must suffer the consequences. It must be apparent to all that to divide all municipal corporations into four classes and to minutely prescribe rules which shall do substantial justice to each individual of each class is practically impossible. Why, for example, should Sioux City be placed in the same class as Des Moines, Ottumwa and Council Bluffs, and compelled by the legislature to submit to the same minute regulations with reference to purely local matters? What does the legislature know of the necessities of these cities? Why should not every city of 25,000 inhabitants be wholly independent of any class? Why should not every such city be permitted to frame its own charter and permitted to govern itself, instead of being governed by a legislature dominated by influences not in sympathy with its commercial life and necessities? In brief, why should not Sioux City be permitted to enjoy home rule to the fullest possible extent with reference to purely local matters?

The legislators in some states are coming to realize the true province of the legislature with reference to cities. In three or four states they have actually begun moving in the right direction. Before we shall have wholesome legislation for our cities it must be learned thoroughly that the city is "primarily an organ for local government—for the satisfaction of local needs, and secondarily an agent of state government." This statement, made by Prof. Goodnow, should be inscribed in letters of gold over the portals of every legislative hall. It certainly needs no demonstration. The legislature should legislate only with reference to those matters in which the state at large has an interest. For example, the following matters are of much more than merely local interest, and as to these legislation on the part of the state is essential: All general provisions relating to the area and boundaries of cities, police administration, public health, the administration of justice, public charity, public education, and some phases of municipal finance. Without going into details, it is sufficient to say that it is to the interests of the entire state, as well as the particular municipality, that all the matters enumerated should be subject to more than local control. They are matters of general public concern. Generally, in all other matters the state at large has no interest. As to them the legislature should keep "hands off," and each city should be permitted to work out its own salvation without being hampered by restrictions which may be of benefit to other cities, but not to it.

What we need is a clearly defined policy in legislating for our cities—a policy founded upon the theory that legislation on the part of the state should be rigidly confined to those matters in which the state at large has a direct interest, and that all other matters should be left to the city itself to legislate regarding in such manner as to it may seem best. In some states this policy has been adopted. At the present time in California any city with a population of 3,500 may frame its own charter, subject to certain restrictions and limitations expressed in the constitutional provision permitting it. A similar constitutional provision is found in Missouri. St. Louis and San Francisco have framed and adopted their own charters in much the same manner as a state adopts its constitution. Like opportunity is of course enjoyed by Kansas City and Los Angeles. The Missouri and California plan was adopted in the state of Washington in 1889, and all cities having a population of 20,000 in that state have the right to frame their own charters. Seattle and Tacoma have taken advantage of this provision. Minnesota has fallen into line and adopted a constitutional amendment by which cities in that state are permitted to frame their own charters within general limits prescribed by the legislature. In 1902 Colorado adopted the most radical home rule constitutional provisions to be found anywhere. Under these provisions any city with a population of over 2,000 may frame its charter.

Iowa should repeal the present Procrustean provisions relating to her cities, and at least permit any city with a population of over 25,000 to formulate its own charter, subject to certain general laws relating to matters in which the state at large has an interest, and thus permit the cities of the state to individually carve out their own future. Each would then be able to make the most of its local conditions and opportunities. It would give greater flexibility to municipal government, and would, I believe, result in the taking of greater interest in municipal affairs on the part of the people of our cities.

II.

Similarly, though of course to a much less extent, there has been legislative tinkering with reference to the duties of the mayors of our cities. The disposition has always been to distrust both the mayor and the city council, and the tendency is to show that distrust by a limitation of their powers. The result of such legislation, and the result of the indifference of the people as to the character and the qualifications of men elected to the office of mayor, is that the office is generally filled with men of little individuality.

In brief, the mayor is made by statute the conserver of the peace, keeper of the seal, the servant of the council and its presiding officer. He is required to report to the council concerning municipal affairs, to supervise the conduct of the officers, and to recommend to the council advisable measures. He is not charged with the duties of an executive officer beyond the limits referred to. He does not have the power to appoint the principal administrative officers of the government. He is graciously accorded the privilege of appointing a chief of police, and the members of the police department, and some of the officers of the health department, but he may not even appoint the members of his police force without the concurrence of the council. With such limitations prescribed by law, his duties and powers are by no means as great as the English town clerk.

The mayor should be made an officer of greater responsibility, both by legislation and in the popular estimation. His duties and powers would undoubtedly be increased, in the ordinary city, if it were accorded the privileges of municipal home rule in a practical sense. Until cities are given home rule the statutes should be so changed as to make the executive not only the nominal, but the actual, responsible head of the city government. He should have the power to make all appointments of administrative officers, even some of those which are now elected. The mayor should not be required to share any of his appointive responsibility with the city council. A divided responsibility invariably leads to bad government. Neither should he be permitted to divide responsibility, properly his, by having even the least administrative duty performed by the city council. Such a division of duties is demoralizing, both to the office of mayor and to the office of councilman. The mayor should also be held accountable for the financial policy of his administration. He should accordingly be required by law to present to the city council a budget at the beginning of each fiscal year, and to take direct charge of, and be responsible for, the proper carrying out of the policy thus adopted. Under the law as it exists he is charged with no duty whatsoever relative to the fiscal policy of the city. Having no duty in that regard, he, of course, assumes none. The fiscal policy of the city is therefore permitted to shift for itself. It is not to be wondered at that the average Iowa city is on the verge of bankruptcy. Indeed, it is a marvel that it has any financial standing whatsoever.

With reference to the benefits resulting from vesting in the mayor the power of appointment and removal, Hon. Seth Low said, in 1888, with reference to Brooklyn: "The mayor appoints absolutely, without confirmation by the common council, all executive heads of departments. He appoints, for example, the police commissioner, the fire commissioner, the commissioner of city works, the corporation counsel, the city treasurer, the tax collector, and in general all the officials who are charged with executive duties. The community, however, is so well satisfied that the charter is a vast improvement on any system which it has tried before that no voice is raised against it. It has had one notable and especially satisfactory effect. It has made clear to the simplest citizen that the entire character of the city government for two years depends upon the man chosen for the office of mayor. As a consequence more people have voted in Brooklyn on the subject of the mayoralty than have voted there as to who should be governor of the state or who should be president. This is a great and a direct gain for good city government, because it creates and keeps alert a strong public sentiment and tends to increase the interest of all citizens in the affairs of their city."

III.

With reference to defects in municipal government in Iowa so far as those defects relate to the city council, I feel that by reason of my experience I can speak with some degree of confidence and authority. I shall indicate the defects which I have in mind by making specific recommendations of methods by which it might be greatly improved.

1. The functions of the city council, both in theory and practice, should be carefully limited to that which is distinctly legislative. One of the greatest evils in municipal government arises from the fact the council is given, and frequently assumes, administrative functions —functions which, in a well regulated city government, should wholly devolve upon the mayor's subordinates. Administrative powers conferred upon the council affords too great an opportunity for aldermanic graft. Such a distribution of powers results in lack of efficiency, for neither councilmen nor council committees can devote the time, and generally they do not have the qualifications to properly and economically administer a department. Let me give a particular instance: It has heretofore been the custom in Sioux City, when the scavenger work has not been done by contract, to have it done under the immediate direction and supervision of the chairman of the health committee of the city council. I believe that my associates will agree with me that that plan is not the best when economy and efficiency is considered, and that a great improvement was effected when the work of supervision was taken from the committee by the present council and placed in the sole and exclusive charge of the scavenger inspector, who is now made the responsible head of that department and directly accountable for its proper, efficient and economical administration. The only additional change I would suggest is that the inspector be appointed by the mayor and accountable to him alone, thus making the office and the administration of it wholly independent of the council. This is but an illustration of what might be accomplished in other directions by drawing a well defined line between executive and legislative functions, and carefully restricting the city council to the latter. Practically as well as theoretically it would be as consistent and proper for the legislature of the state to perform some of the duties of the governor as it is for the council to perform duties of the mayor or his subordinates.

2. Another defect in Iowa municipal government, so far as the council is concerned, is in the election of

councilmen. I have no hesitancy in saying that councilmen should all be elected at large. The ward system with its single representative should be abolished. The ward was contrived for the benefit of the politician and the ward heeler, and not for the benefit of good government. In Iowa there is no uniform rule as to the number of councilmen, excepting that the statute requires that one be elected for each ward, and that two be elected at large. In the larger Iowa cities the number varies from seven to eleven. In Memphis and San Francisco all the members of the legislative body, corresponding to our council, are elected on a general ticket.

The committee on law reform of the Iowa State Bar Association recently made the following recommendation:

"That the municipal government of Iowa cities should be vested in a council of three aldermen, whose term of office should be three years, after the first council, the members of which should serve respectively one, two and three years, to be determined by lot; thereafter one alderman to be elected annually; such alderman to be elected in all cases by a vote of the whole city, and vacancies to be filled by special elections, such councils to be vested with all the present powers of city councils and to elect one of their members as mayor to exercise all the duties of mayor, as defined by law; such aldermen to be paid from two thousand to five thousand dollars per year, depending upon the class of the city, with additional compensation to the mayor; all to be fixed by law; the said aldermen and mayor to be required to devote their entire time to the discharge of their duties. That the statutes of Iowa should be amended accordingly."

The election of councilmen on a general ticket would give us, as a rule, men who would act for the interests of the city as a whole, and I know that there would be much less log-rolling—a practice which costs cities thousands of dollars every year. With a council so chosen I am sure that it would be composed of better men—men who would attempt to give, and succeed in giving, the city a much more businesslike and economical administration of its affairs. I think, however, that a council of three members would give too great an opportunity for unity of action in evildoing. In a council with a larger membership one or more are generally found who will not enter into combinations and schemes, but who will make public and open opposition thereto. There is nothing which a grafter, a political schemer or a corporation lobbyist tries so much to avoid, and there is nothing which lends so much to honest municipal government, as publicity.

IV.

Another example of a blind attempt on the part of the legislature to effect a reform in municipal affairs, resulting in failure so far as efficient government is concerned, is the invention of the board and the commission. Nothing could be more unscientific in theory and nothing but utter failure can possibly result therefrom in practice. The board or commission is neither a part of the executive branch nor of the legislative branch. It is mongrel, and like all mongrels it is an outcast. It affiliates neither with the executive officers nor with the legislative officers. Take, for example, the board of waterworks trustees and the board of park commissioners as they are constituted by statute. They are accountable to neither the mayor nor to the council, so far as their official acts are concerned. They receive the money from the taxpayer and spend it, with no officer or body of men whose duty it is to audit or approve their bills before they are paid. They do their own legislating, pass judgment upon all matters within their respective departments, and their action, whatever it may be, is practically conclusive.

The great and serious objection to the board and commission is in the fact that there is absolutely no cooperation between the various boards themselves, or between them and the council or the executive department. Each is independent of the other and is made so by statute. Each adopts its own policy, which may or may not be in harmony with the policy of the administration.

Suppose the finance committee, the grading committee, the sewer committee and the street committee of the city council were each to act independently of the other, and not attempt to work in harmony with each other or with the council as a whole, what sort of a city government would we have? Suppose a great manufacturing business were run on a similar plan, what would be the result? It would certainly end in disaster. I would abolish every board and commission connected with municipal government in Iowa. There is no excuse for its existence. They make the administration of municipal government expensive and cumbersome. They are the boon of the politician and the place-hunter. They were contrived for the purpose of limiting the powers of both the executive and the council, and the result is a "jump from the frying pan into the fire."

The law should be so amended as to require the mayor as the responsible head of the executive department of the city government to appoint a superintendent of waterworks and a superintendent of parks, and I am sure that we would then have a more efficient administration of these departments. Occasionally a bad appointment will be made, but the result certainly cannot be worse than to have these departments administered independent of, and wholly out of harmony with, the remainder of the administration.

V.

Finally I would recommend a change which may be difficult of accomplishment, on account of the necessity of amending the state constitution, and yet I deem it one of prime importance. I refer to a change in the constitutional five per cent. limitation on the debt incurring capacity of Iowa cities. Iowa is no longer a frontier state. Her cities are prosperous and growing, and will continue to grow. The public utilities owned by the cities must therefore continue to enjoy ever-increasing earning capacity, and in many, if not in most, of the cities continuing profits on municipal plants are assured. While there is abundant reason for curbing extravagance on the part of cities by limiting their debt contracting ability for general purposes, there does not exist the same reason for limiting, to the same extent at least, the debt contracting ability for the purpose of constructing or improving revenue producing municipal plants. Sioux City is at the present time experiencing the ill effects of this five per cent. limitation. It has a waterworks plant worth approximately $1,000,000, with only a nominal indebtedness. A large sum is needed for improvements to the system in order to meet growing municipal needs, and we are practically helpless, so it is claimed, on account of the fact that the city has exceeded its constitutional limit of indebtedness, although the net income of the plant will pay interest on at least a half million of bonded indebtedness. I am sure that the framers of the state constitution never contemplated such a condition and actual hardship, and I am equally sure that at the proper time, if the matter is fully understood, a change can be effected, and an exception made where the indebtedness is incurred for the purpose of constructing or improving revenue producing plants. We can all readily agree with Bird S. Coler when he says that this constitutional limitation "should not be made a fetich to be worshiped blindly at the expense of really necessary progress."

Bonds issued for the payment of public utilities are not real burdens on the taxpayers. The municipality's debt incurring power for the purpose of making nonessential public improvements should be limited, but for those things which are essential to public health and comfort, like pure water in abundance, there should be no constitutional bar. It is well to have restrictions and limitations, but nothing is to be gained by having restrictions and limitations which in their operation must of necessity result in depriving us of those things which aid in bringing about better conditions of municipal life.

Other reforms in the present method of governing Iowa citites might be suggested. The merit system, for example, should be reasonably and practically applied to the civil service. The referendum law should be extended. But a discussion of these and other subjects would unduly prolong this paper.

I have not attempted to point out numerous minor defects in municipal government in Iowa, but only those of the more noticeable and general nature. Investigation and experience convinces me that what I have suggested would be in accord with the trend of the more modern view of municipal affairs, and I am convinced that if these recommendations could be adopted they would lead to a greater degree of interest on the part of the citizen and a much more efficient and economical administration of our city governments.

PROGRESS AND PROBLEMS OF SOLAR PHYSICS DURING THE LAST FIFTY YEARS.

BY DAVID E. HADDEN.

At the beginning of the century which has recently passed into history little was known of the science of Astronomical Physics, absolutely nothing was known about the physical composition of the sun, planets or stars. In the year 1802 Wollaston was enabled to see the dark lines in the solar spectrum by substituting a slit for the round hole of Newton's method for studying the spectrum, but he, supposing that these dark intervals were simply boundaries between the seven primary colors of the spectrum, gave the matter no further attention and Astrophysics had to wait for fifty years, until Swabe announced the discovery of the Sunspot period in 1851, when it was soon found that the earth's magnetism and the displays of Northern Lights obeyed the same law of change.

A few years later Kirchoff in his studies of the solar spectrum announced to the Academy of Sciences of Berlin the results of his investigations into the chemical interpretation of the lines in the solar spectrum and the presence in the sun of iron, calcium and other familiar metals, this classic discovery was the beginning of the modern science of Astrophysics.

Astrochemistry now developed with rapidity and the spectroscope became a new and powerful instrument of research; the brilliant beams of sunlight, as well as the feeble rays from myriads of stars, were awaiting the results of analysis by means of the integrating prism.

In 1864 Dr. Huggins (now Sir Wm. Huggins) began his studies of the spectrum of nebulae and showed that planetary and all irregular shaped nebulae were largely of a gaseous constitution, and in 1876 he introduced photography to the study of stellar spectra, and since that time the progress of this branch of Astronomy has been rapid and marvelous; in fact, the wonderful progress which Astronomy and Astrophysics have made during recent years is largely due to the adoption of Astrophotography.

Astrophysics, though widening in scope each year, is but yet in its infancy, the problems confronting the astronomer of today in seeking to solve the physical constitution of sun, moon, planets, asteroids, comets and distant stars and nebulae are well nigh as boundless as the universe in which they shine, and with every advance in our knowledge of them proving to man in the words of Addison that "The hand that made them is divine."

The progress of solar physics during the past fifty years has been marked by many far reaching and brilliant discoveries; it was during the total eclipse of the sun July 18, 1860, that the photographic plate demonstrated the solar location of the red prominences and at the Indian eclipse of August 18, 1868, the spectrum of the prominences was observed to consist of the bright lines due to hydrogen and helium. In the following year the Coronium ray was seen, and in 1870 Professor C. A. Young caught sight of the momentary but brilliant flash spectrum of the reversing layer, which in recent years has been so successfully photographed.

It was early discovered after the interpretation of the Fraunhofer lines that the old Herschelian theory of the sun was doomed, and it remained for the New Astronomy to formulate solar theories, which are yet in process of elucidation and verification.

Our sun is not a solid, nor yet a liquid globe: it is mainly of the critical gaseous liquid nature subjected to tremendous pressure and temperature, with enormous convection currents carrying their supply of electrical or other energy in an increasing quantity from the reservoirs beneath to the photosphere above; over this dazzling surface the spectroscope has demonstrated the existence of several shells or envelopes and has enabled us to determine their constitution.

Professor Young [a] regards the photosphere as a shell of clouds, columnar in form owing to the ascending currents by which they are formed, and Professor Johnstone Stoney and Sir Robert Ball state that undoubtedly carbon is one of its main constituents.

Above the photosphere is supposed to exist a thin veil of "smoke" or relatively cooler gas by which the disk is darkened; above this is the reversing stratum—a layer of various incandescent metallic vapors which absorb the various rays of the intensely heated and brilliant elements of the photosphere and produce the familiar dark Fraunhofer lines of the solar spectrum—still higher up is the chromosphere, a region some five or six thousand miles in depth, composed principally of hydrogen, calcium and helium, and in which appears the beautiful forms of the quiescent and eruptive prominences, while above all and reaching at times to many millions of miles is the marvelous Corona only visible in all its beauty at a total solar eclipse.

The application of the spectroscope to the problems of solar chemistry has been productive of rapid and important advances in the physics of the sun in recent years; the Fraunhofer lines in the spectrum have been photographed and studied by elaborate appliances and delicate instruments and by means of almost perfect screws the late Prof. Rowland made possible the use of plane and concave diffraction gratings ruled with equidistant lines, 20,000 to 40,000 of which were ruled on a linear inch of polished speculum metal. With such powerful means of light analysis the accurate position of many thousands of dark lines in the solar spectrum has been determined in terms of their wave lengths to the tenth-millionth of a millimetre. With such diffraction spectroscopes the study of the chromosphere and prominences is carried on daily by scores of observers in all parts of the world, who are accumulating and discussing masses of data which are certain to bring forth new and important discoveries relating to the great problem of physical life on our earth.

With the advent of the chemical interpretation of the dark lines in the solar spectrum came more refined methods of determining the positions of every line and their delineation in maps, extending from the infra red far into the ultra violet rays of the spectrum.

While the visible spectrum extends only about from line A in the red to G or H in the violet, Professor Langley, of the Smithsonian Institution, by means of his marvelously delicate bolometer, has been able to detect differences of heat radiations less than one-hundred millionth of a degree, Centigrade, and thus extend the region of the infra red or heat spectrum, to a distance of eight or ten times that of the portion visible to the human eye; little, however, as to the constitution of the sun has been learned from this source as yet.

In the ultra violet direction the photographic plate has extended our knowledge of this region to a distance of about wave-length 2950, at which point the absorption of the atmosphere puts a stop to further action on the chemical plate.

In 1889 Rowland published his great photographic map of the solar spectrum, which was a monumental document, and in the years 1895-1896 and 1897 published his "Preliminary Tables of Solar Wave-Lengths" comprising over 20,000 lines, the accurate wave-length and element to which each belonged being given. The following list of elements in the sun are taken from his researches:

Aluminum, Barium, Copper, Cobalt, Chromium, Carbon, Cerium, Calcium, Coronium, Cadmium, Erbium, Glucinum, Galium, Germanium, Hydrogen, Helium, Iron, Lead, Lanthanum, Magnesium, Manganese, Molybdenum, Nickel, Niobium, Neodymium, Oxygen, Palladium, Potassium, Rhodium, Sodium, Silicon, Scandium, Strontium, Silver, Tin, Titanium, Vanadium, Yttrium, Zinc and Zirconium. Of the thirty-five or more remaining known elements no trace could be found of sixteen of them, eight were doubtful and the balance had not yet been tried. It is possible though, as Rowland states, that all the known elements may be present in the sun and that if the whole earth were heated to the temperature of the sun, its spectrum would probably resemble that of the sun very closely.[b]

The solar spectrum differs from all other spectra in the number and peculiarity of its dark lines, many thousands of which have not yet been identified with known terrestrial substances; but with the aid of the photographic plate this work is proceeding slowly and in course of time it will have given up all its secrets. Professor Rowland was actively engaged upon this great task of photographing the spectra of all known elements for comparison with the solar record when death cut short his brilliant and busy life in 1901.

Not all the dark lines are due to solar origin, many hundreds being purely telluric, part being the result of dry air absorption, while others are caused by the selective absorption of aqueous vapor. The method of detecting telluric from solar lines is interesting and depends upon their not shifting position with the rotation of the sun on its axis; lines which are purely of solar origin will by their displacement towards the blue end indicate a motion towards us of the sun's eastern limb, and a recession of its western limb being accompanied by a shifting towards the red. Many other lines in the solar spectrum seem to be variable. Sidgreaves, Cortie, Lockyer, Rowland and others have called attention to some examples of lines which at times are very faint and missing, and afterwards gain in intensity. No explanation as yet satisfactorily accounts for this phenomenon; it may be connected in some manner with the periodicity of the solar spots.

Many other changes have been observed in the Fraunhofer dark lines. Professor Jewell has observed displacements of lines which were not due to motion, but to the condition of the elements producing the dark line displacement, increased density or pressure affecting the wave lengths of the lines. This discovery will have an important bearing in future investigations not alone upon the sun, but also upon other bodies, such as comets, nebulae and stars.

During the solar eclipse of December, 1870, Prof. C. A. Young made the interesting discovery that at the moment of second contact of the sun's and moon's limbs the dark Fraunhofer lines visible in his spectroscope were suddenly reversed, and the field of view presented a series of bright lines upon a dark background. This result was not unlooked for, but the question as to whether it was a complete reversal of the dark lines could not be decided in a second or two of precious time by the eye alone, hence a more permanent means of recording it was sought, and this was secured by photographic means at the eclipse of August, 1896, and also in each succeeding obscuration of the sun to the present time. The result of an investigation of all the observations to the present seems to indicate that the shell of various metallic vapors resting upon the photosphere is a true reversing layer about 600 miles thick, and is the location of the dark absorption lines by means of which we are enabled to unravel the secrets of the solar constitution. This layer is cooler than the photosphere, which has a temperature of about 6590 degrees centigrade, according to W. E. Wilson's researches in 1901.[c]

Perhaps the most interesting of the solar constituents are the gases Helium and Coronium, both of which were supposed to be solely solar products, being only visible at times of eclipses, and in the prominences and chromosphere by means of the spectroscope daily.

Helium manifests its presence by a bright yellow line near the sodium D lines, and the designation D_3 was given to it at the eclipse of 1868. It is not visible in the Fraunhofer spectrum, and although it appears to be an abundant element in the solar atmospheres, no trace of it can be detected in the reversing layer. In 1895 Sir Wm. Ramsey, while experimenting with Argon, succeeded in discovering Helium in a kind of pitch-blend known as cleveite, whose spectrum showed the characteristic yellow lines, and the mysterious substance was found to be also a product of our own globe, though in very limited quantities. Its chemical nature is unique; it is monatomic, non-valent, and enters into no combinations; it has an extremely low refractive index and is an excellent conductor of electricity. It is a conspicuous substance in nearly all eruptive and quiescent prominences. The writer has very frequently observed these phenomena by means of the tele-spectroscope in the D_3 line, the forms of the delicate filaments and cloud-like masses being nearly as distinct as through the familiar hydrogen line in the red end of the spectrum.

Of Coronium we know but little, seen only as a bright green line at a time of a total eclipse of the sun; it certainly exists in large quantities in the solar vapors reaching far out into the tenuous gases of the Corona. It was first detected and its position marked by Prof. C. A. Young in 1869. In the eclipse which was visible in the southeastern states in May, 1900 (and of which the writer was an interested observer) this veteran and honored astronomer again endeavored to secure the accurate wave-length of this green line in the spectrum, and although supplied with a powerful spectrograph and a visual integrating spectroscope he was unable to see or photograph the line owing to its faintness at that eclipse, although in preceding eclipses he had no difficulty in observing it.

Of the precise nature of the photosphere the spectroscope as yet offers us no positive information. Young believes it to be a sheet of luminous clouds floating in permanent gases of the solar atmosphere, but no one can yet positively state the actual constituents of this cloud mass.

It is supposed that the substances revealed by the spectroscope which produce the Fraunhofer lines, namely, the gases, metals and perhaps carbon, are the constituents, and this is probably true, but many other theories, some of which are of an electrical nature, have been advanced, and the whole question is still one of great interest to students of solar physics.

Regarding a well formed group of sun spots, Professor Young says that "the umbra, with its central nuclei, and overlying bridges, veils and clouds; the penumbra, with its delicate structure of filaments and plumes; the surrounding faculae and the agitated surface of the photosphere in the whole neighborhood of the disturbance; above all, the continual change and progress of phenomena—combine to make a fine sun spot one of the most beautiful and intensely interesting of telescopic objects." [d] Observations of these objects have been made ever since the days of Galileo in 1610, but it is only within the last thirty-five or forty years that they have been observed and studied with any accuracy and regularity. As it is principally from a study of the sunspots that we are likely to gain any knowledge of the constitution of the sun's interior, a short account of their structure, appearance and phenomena may be given here: Sunspots, unless very small, usually consist of two or three parts. the penumbra or outer fringe of a grayish color enclosing a darker central portion, known as the umbra; within the umbra are occasionally seen still darker, almost black "holes" known as "nucleoli;" surrounding the entire spot or group, and at times extending over enormous portions of the sun's suface in the vicinity of the spots, are masses of faculae which appear much more brilliant than the dazzling photosphere. Sunspots vary much in size and number, and are subject to some as yet unexplained periodicity, being more numerous and larger at times, and then gradually diminishing until the disc may be entirely free for many months or perhaps a year or more; these fluctuations occur on the average every eleven and one-tenth years from a maximum to a maximum again, although many exceptions to this period are recorded; from a careful record kept by the writer from 1890 to the present time, the last maximum was passed in 1893, and the following minimum was not certainly reached until September, 1901,[e] the interval from one minimum to the other extending over a period of twelve years. The period of increase from minimum to maximum is more rapid than the decline, and the next maximum is due during the first half of the year 1905.

Sunspots are supposed to be cavities in the photosphere which may be filled with cooler vapors and gases, rendering the spot darker in color, but this is only a theory, and of late it is seriously questioned, some spots appearing to be at much higher levels than others, and possessing a convex rather than a concave shape. Authorities among solar physicists differ even from geometrical considerations of the formation of sunspots as they cross the disc, and the whole question is yet one for earnest and persistent thought and study. A single normal sunspot is the exception; usually they appear in clusters, groups, trains, streams and small spots, dots or veiled markings; they present an endless variety of forms, some with numerous umbrae, others spiral-shaped, oval, circular, carrot-shaped, pear-shaped, scorpion-like and many other curious formations; many large spots present evidence of violent cyclonic action, others of gigantic explosive violence, rending portions of a spot in all directions; spots are frequently "bridged," while others have variously colored umbrae, being brown, brownish-red and purple. Some groups and single spots are of enormous dimensions; descriptions of some of these giant disturbances which have come under the writer's observation during the past twelve years were described in a paper presented to the Iowa Academy of Sciences about a couple of years ago.[f]

The finest group which has been seen so far during the present cycle of solar activity was during the month of October, 1903, when a spot group of the very first magnitude was observed. This disturbance reached a maximum length of 130,000 miles, a width of 40,000 miles and embraced an area of more than 2,400,000,000 square miles of the solar surface. Remarkable aurorae and other widespread electrical and magnetic effects were coincident with the appearance of this group.

The spectrum of sunspots is rather complicated and of great interest; a general absorption takes place along the whole length of the spectrum. In 1883 Professor Young discovered that the upper portion of this spectrum was of this character mainly, while the middle part of the spectrum was somewhat different, and in large spots with dark nuclei the region between the lines E and F is not continuous, but made up of countless fine dark lines, with here and there probably bright lines, each line being spindle-shaped, tapering to thin fine marks across the penumbra to the general surface of the sun; but the portion of the spectrum between C and D is much more interesting; many lines become much widened and darkened in this region, while others which are ordinarily faint become very conspicuous; some are reversed and become bright, and again many which are usually strong become weak and almost fade out. My esteemed correspondent, Rev. A. L. Cortie, S. J. Director of the Solar Section of the British Astronomical Association, has recently presented a paper on the Spectra of Sunspots in the Region B-D to the Royal Astronomical Society[g] in which he reviews a series of observations carried on between the years 1890 and 1901, and has classified his results under the following heads: Widening of lines, darkening of lines without widening, displacement of lines, obliteration of lines across spots, reversal of lines, hazy fringes to lines and spot bands. He found the D lines of Sodium reversed and displaced, the Ha line of Hydrogen rarely widened, but frequently reversed, twisted and displaced. The lines due to the elements Vanadium, Chromium, Sodium, Titanium, Calcium, Cobalt, Nickel, Oxygen, Manganese and Iron were mainly involved in the spectra of the sunspots examined. The spectrum of sunspots appears to undergo decided changes at the epochs of maximum and minimum sunspot frequency; the lines most widened near the minimum period being mainly the known lines of the metals, whereas those affected near the maximum belong to the unknown class.

Frequently sunspots exhibit evidence of violent agitation of the gases overlying the disturbed region by reversals, displacements and distortions of lines; the hydrogen, helium and calcium lines are those principally affected, although double reversals are sometimes detected in the sodium and magnesium lines.

Occasionally the eruptions in active spots are so striking and brilliant that the forms of the gaseous masses can be clearly seen with the spectroscope. Several of these occurrences have come under the writer's notice; one in particular accompanied the enormous group visible in the month of September, 1898. This disturbance was remarkable for the various magnetic and electrical manifestations which accompanied it on the 7th. As the group was nearing the central meridian the entire region in the vicinity of the group was violently agitated, the hydrogen C line was reversed and distorted in all directions, and upon opening the slit of the spectroscope the flame and spike-like form of the incandescent clouds was clearly seen extending from the umbra to the edge of the penumbra on the east edge; the D_3 line of helium was also bright and the sodium D lines and others widened. Such outbursts as these are probably identical with the metallic protuberances seen at the edge of the disc, but which cannot be so readily observed on the more brilliant background of the solar surface. The very complex character of sunspot spectra demands much more attention at the hands of solar observers, and many problems connected with them are awaiting solution.

No less interesting than the dark spots on the solar surface are the irregular streaks and large masses of greater brilliancy than the general surface of the disc, which are at all times present in greater or less numbers, except at a period of sunspot minimum, when they also disappear, and leave the brilliant orb of day spotless, tranquil and serene.

Without question now these faculae are elevated portions of the photosphere. This can be clearly seen by direct observation. The spectrum also is identical with the continuous spectrum of the photosphere. Formerly they were thought to be luminous masses of calcium vapor floating in the solar atmosphere and possibly identical with the prominences. This view originated by the observation of double reversals of the great H and K bands due to calcium in the solar spectrum and the spectroheliograph work of Hale and Delandres; but in a very recent paper by Professors Hale and Ellerman, of the Yerkes observatory, on Calcium and Hydrogen Flocculi [h] the authors give a brief description of some of their latest investigations into the nature of these phenomena. Their conclusion is that the faculae are elevated regions of the photosphere characterized by a continuous spectrum, but the flocculi are clouds of gas or vapor lying at a higher level than the faculae, and are only visible in photographs taken with the spectroheliograph.

Two varieties of prominences differing visually, chemically and in solar location are observed,—the eruptive or metallic, and the quiescent or hydrogen forms. The eruptive variety is by far the more interesting, consisting of mainly compact forms resembling banyan trees, spike-like jets and flames, etc., of an intense scarlet color and appearing principally in the sunspot zones; while the quiescent variety are more cloud-like, often of great extent, with occasionally explosive outbursts, and found in all directions from the poles to the solar equator. The eruptive class usually attain heights of about 20,000 to 30,000 miles, although occasionally they reach to much higher altitudes; while the quiescent form vary in height from about 7,000 or 9,000 to 30,000, not infrequently to 80,000 and 100,000 miles, and some have attained the enormous altitude of 350,000 miles above the surface of the photosphere.

The spectrum of the quiescent variety is usually simple—hydrogen and helium being the principal constituents, although magnesium and sodium are sometimes present, but the eruptive prominences emit a very complicated and interesting spectrum which consists mainly of bright lines due to iron, barium, magnesium, sodium, calcium, manganese and chromium. These prominences are usually seen in the vicinity of sunspots, and seem to be connected with them by some means. An instance of a particularly brilliant prominence came under the writer's attention on October 23, 1896, when a small but violently agitated prominence was observed very near or perhaps directly over a sunspot which was at the extreme edge of the sun's eastern limb just coming into view; the hydrogen lines were blazing, the Ha line especially presenting a winged appearance, with jets of hydrogen directed towards both ends of the spectrum, indicating motion of the gases away from us and towards us in the line of sight. Such disturbances usually change their form very rapidly; a period of fifteen to twenty minutes suffices to produce changes in the appearance which would hardly be recognizable by the same observer. This disturbance completely subsided in an hour's time.

The enormous velocities observed in these objects which often exceeds a hundred miles per second, and occasionally goes beyond the critical rate of 383 miles per second, which is in excess of the power of the sun's gravitation to retain a substance, presents a problem which is baffling to solar physicists. Quite recently, however, Prof. W. Michelson has given a new explanation of the displacement of spectral lines on the sun which may throw new light on these objects; he shows that a displacement of lines must occur when a denser mass is introduced in the path of a ray of light. While this theory does not supplant Doppler's principle which cannot be done away with, it seems to permit of a more satisfactory explanation of the displacement of spectral lines in the case of the prominences; but future researches at a time of sunspot maximum will probably be necessary to confirm the theory.

In the year 1891 Professor Hale, of Chicago, was first enabled to secure a photograph of a solar prominence in full daylight by means of his spectroheliograph, which consisted of a powerful spectroscope with two automatically moving slits, one at the collimator and the other at the eye-end of the view telescope. These slits are so adjusted as to only admit the H or K line light of calcium to the photographic plate while the image of the sun is slowly drifting across the first slit plate. By this means photographs of the prominences, chromosphere and faculae were taken daily and are available for study at leisure at any time. More recently the great Rumford spectroheliograph attached to the gigantic forty-inch telescope of the Yerkes observatory in the hands of Professor Hale has yielded most important results, and astronomers look forward to future researches with this giant instrumental equipment with great interest.

The sun's chromosphere presents an interesting bright line spectrum, consisting chiefly of hydrogen, helium and calcium. Professor Young gives a list of eleven lines which are always observable in the chromosphere, three being due to helium, five to hydrogen, two to calcium and the Corona line, and a list of thirty-four others which are more or less conspicuous at certain times, and under perfect conditions of seeing; these comprise in addition to the elements mentioned iron, barium, sodium, titanium, chromium, magnesium, manganese and strontium. During the eclipse visible in India in January, 1898, the elements scandium and gallium were added to the chromospheric list, and in September, 1897, Professor Hale discerned carbon bands at the edge of the sun, from which he inferred the existence of carbon vapor as a solar layer; this envelope may be from 500 to 1,000 miles thick. Professor Young's latest views on the reversing layer and chromosphere are that they are "simply the uncondensed vapors and gases which form the "atmosphere" in which the clouds of the photosphere are suspended. This atmosphere resembles a sheet of flame or "prairie on fire," as Professor Langley describes it.

The reversing layer is the thin stratum at the base of the flame-sheet, which is seen as the bright line "flash" spectrum for a few seconds only during solar eclipses.

The chromosphere is the region immediately above the reversing layer, consisting of the gases and vapors which are non-condensible under the conditions there prevailing."

A total eclipse of the sun is without question one of the most impressive and magnificent scenes visible to the human eye. The gathering gloom, the deathly ashen hues everywhere present, the strange pallid tinge which steals over the faces of men, the weird and darkening landscape, and the sombre gray deepening into the purple sky combine to produce a vivid impression on the mind which can never be forgotten.

It was the good fortune of the writer to have been able to station himself near the center of the track of the shadow which darkened our southeastern states on the 28th of May, 1900, and to have witnessed some of the glories which only reveal their presence while our brilliant sun is in eclipse. Perhaps no total eclipse in recent years was so well observed, the shadow track where it passed over the land surface being in easily accessible places, and the weather propitious at all points where observers were stationed. The writer viewed the phenomenon from Wadesboro, North Carolina, where were also stationed expeditions from England, Canada, the Yerkes and Princeton observatories and the Astrophysical observatory of the Smithsonian Institution, besides many smaller colleges and private observing parties. The equipment of cameras, telescopes, spectroscopes and other appliances for studying this eclipse was probably the largest and best ever heretofore utilized on a like occasion. The results, while highly important in many respects, really added but slight addition to the sum total of our knowledge concerning many of the sun's problems.

The Corona was of the typical form due to a quiescent condition of the solar surface,—extended equatorial extensions,—instead of the radiated structure which belongs to the sunspot maximum period. This feature of the relationship of coronal type to the development of solar spots was first suggested in 1878 by Hansky, and the form of each succeeding eclipse had so fully confirmed his discovery that in 1896 he forecasted the general appearance of the corona of 1900, which in the main proved to be verified. The question of coronal modifications due to chromospheric eruptions, first noticed by Belopolsky in 1897, has received confirmation in later eclipses, that of 1901 disclosing to Professor Perrine, of the Lick observatory, a violent coronal disturbance issuing from the vicinity of a small bright prominence.

The spectrum of the corona appears to possess a triple origin: a continuous spectrum, both original and reflected, and a gaseous of bright line emissions; these vary at times, the discontinuous being feeble, especially near the sunspot minimum epoch. About a dozen coronal lines have been observed with the spectroscope. The fundamental green ray designated as the "Coronium line" was traced to a distance of 325,000 miles in the corona during the eclipse of 1889 by Keeler, but it is still of an unknown substance. The original continuous spectrum appears to emanate from incandescent solid or liquid particles from the interior corona, and seem to be of a phosphorescent nature, with little or no thermal radiations. The reflected continuous spectrum is slight, but clearly present at times, and mainly in the remoter portions of the corona, Perrine having found thirty-five Fraunhofer lines in his study of the photographic results of the eclipse of 1901. This reflected light is probably due to dust or fog according to Young, or some matter which reflects sunlight; polariscopic observations also confirm the presence of reflected light.

Interesting speculations as to the nature of the corona still occupy the attention of solar physicists; that it is a true solar appendage and not an optical phenomenon, as formerly supposed, is now proved.

Professor Young suggests that it may be similar to Roentgen and cathode rays due to ions driven off from the molecules of the solar gases and controlled in their motions by electric and magnetic forces emanating from the sun.[j]

Sir Wm. Huggins considers the corona to be a halo of "incandescent fog." Professor Newcomb suggests detached particles, wholly or partially vaporized, while Bigelow presents an electro-magnetic theory, based on a study of the coronal structure as discussed by spherical harmonics; all these theories seem to have some points which can be accepted as true, but the whole problem is still baffling and must await the results of future investigation.

In concluding this review of the progress of solar physics since the advent of the spectroscope and photographic plate and their application to the study of the sun's consitution, a short account of the problems yet remaining partially or wholly unsolved, the solution of which will so materially assist us in solving some of the great problems of life and energy on our earth, may be of interest.

Perhaps the most important problems connected with the nature of the sun are, according to Miss Clerke's admirable discussion of the sun as a whole,[k] its rotation and its periodicity; regarding the former little more is known at present than before the spectroscope was applied to the telescope; true it has told us much more about the peculiarities of the sun's rotational motion than could have been deduced from a study of sunspots alone as was done by Carrington and others, but as to the underlying cause of the anomalies of rotation nothing is known. Duner has summed up his conclusion thus: "I must confess that this difference between the rotation periods in the different solar latitudes appears to me incomprehensible, and constitutes one of the most difficult problems of Astrophysics." [m]

The solar periodicity is another intricate problem awaiting solution by astronomer or physicist. No satisfactory theory has yet been advanced to account for the eleven year cycle first discovered by Schwabe in 1851.

Ample confirmation of this periodicity has been obtained since that time, but irregular variations have been noticed and the period from maximum to maximum has varied from seven and one-half to sixteen years; during the recent cycle fully twelve years intervened between minima; and the maximum, which ought to nearly reach the summit of the curve during the year 1904, seems yet some distance in the future, as only comparatively small and few spots have darkened the disc of late. Aurorae and terrestrial magnetism seem to obey the same law of the solar periodicity and are subject to like variations. They are so intimately connected with solar outbursts that often individual large spots are coincident with world-wide auroral, magnetic and electrical manifestations. It is probable that this periodicity is due to the conditions within the sun itself, perhaps owing to the cooling process going on beneath the photosphere; the present activity in the study of variable stars may throw some light on this difficult problem.

Another important question yet remaining unsolved is the constancy of the solar radiation, but investigations now in progress may solve the difficulty. Regarding the effective temperature of the sun, Young in his latest views on the constitution of the sun places it as not far from 6,000 degrees.[n]

Many interesting and ingenious theories have been advanced to account for the maintenance of the sun's radiation: the Helmholtz contraction theory, whereby the sun's globe in cooling contracts, and heat being mechanically evolved as a consequence, was promulgated in 1853, and while probably true may not be the only source of energy. The newly discovered element radium and other radio-active substances may throw much light on this problem.

A curious hypothesis of solar physics was published by Schmidt, of Stuttgart, in 1891,[p] who argued from mathematical and other reasonings that the sun was entirely gaseous and the photosphere and appendages merely optical phenomena due to circular refraction. Enough has been said to indicate some of the great problems which still confront astronomers and physicists respecting the origin, constitution and destiny of the sun and solar system. The progress of knowledge in solar physics during the past half century has been, as we have seen, one of marvelous development, but the knowledge so attained only suggests the greater possibilities and triumphs with which the future abounds.

> "Not in vain the distance beacons,
> Forward, forward, let us range!
> Let the great world spin forever
> Down the ringing grooves of change."

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(b) The Sun, by Young, page 88.

(c) Proc. Royal Society, 1901, December.

(d) The Sun, Young, page 113.

(e) The Solar Surface During the Past Twelve Years, Hadden, Proc. Iowa Academy Sciences, Vol. X, page 86.

(f) Ibid, pages 74-93.

(g) Monthly Notices Royal Astron. Society, June, 1903.

(h) Astrophysical Journal, January, 1904.

(j) Manual of Astronomy, Young, page 246.

(k) Problems in Astrophysics, Clerke, chapter XIV.

(m) The Sun, Young, page 144.

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A THREE-FOLD DEVELOPMENT.

A STUDY IN EVOLUTION.

BY H. C. POWERS.

In choosing as a subject for my paper, the theory of evolution or development by modification of one form or condition from a previously existing one, I shall assume the truth of the doctrine. I have used as a title for what I shall offer, "A Three-fold Development," and shall use as a first term for my trinity the development of the inorganic matter composing this world since it first took form and shape as we know it. It was then a glowing mass of planetary material. At first, and for an almost infinite time afterward, life of any kind could have had no existence on its heated surface. After aeons of time had passed away life appeared, first in the water and later on the land. Evolution, ruling living organic beings as it had the inorganic matter before, developed by slight and slow modification of previous forms all plant and animal life that have since existed. This shall be the second term of my three-fold development. Finally a development in brain and intelligence brought about a still more wonderful advance, culminating in the civilized man of today. This shall be the third term of my theme.

There are two things necessary to life, heat and moisture. Agreeing in this statement, we must believe that life had its beginning in water. This belief is made necessary by the fact that there must have been life in the old primordial oceans myriads of years before there was any soil above the waters that could have sustained life. All soil has been formed by the action of water, either as waves and surf, beating against a rocky shore, grinding down the hard crust of the earth, or as rain, dissolving by the aid of carbonic acid held in solution, the rocks upon which it has fallen, and by its currents carrying the fine material to the ocean or lake, where it was laid down as sediment beneath the waters. The first crust that was formed on our globe over the molten mass of planetary material must have been entirely devoid of life of any kind and unable to sustain it if any chance had cast it upon the shore. The earth must have slowly radiated its heat away into space for unknown time, until it was sufficiently cooled so that the waters, before held in the air as a thick vaporous mass of clouds, preventing the faintest passage of the light of the sun, could have been condensed and precipitated to the surface in rainstorms more violent than any we now have knowledge of. Such water, at that time, must have been thick and heavy with the minerals held in solution that were volatilized by the great heat. At first the vaporous moisture would be condensed in the colder currents of air above the earth and falling towards the surface, would at once be again changed to vapor by the heated rocks and again rise to the air above and only after a long time would it have reached the surface. Thus there must have been a continual change of water, thick with carbonic acid, lime and other minerals, falling to the earth and rising again as vapor. Such action of acidulated water would have disintegrated and broken down the heated rocks very much faster than is now being done. This erosive action would have carried its fine sediment to the low places on the surface, and this, acting as a protecting cover, would have confined the heat and allowed the water to gather there in the depressions, thus marking out the future oceans and continents. With the ever increasing weight of water and sediment, the then thin crust must have continually sunk lower, while the dry land would as naturally have been more and more elevated, and the erosion from the falling rain thus increased.

Oscillation of the surface must, in those young years of the earth, have been much greater than now, changing land surface to sea and elevating the sea bottom above the waters. Most geologists, however, believe that the great continents and oceans were laid out and defined at the beginning, and that the changes in level have been local rather than general; that the great oceans have always been about as they now are, while the continents have held practically the same shape as they now have. A map of the world shows the land surface of the continents radiating away from the north pole, while they all terminate in narrow points before reaching the south pole. As we believe that the land and water surface of the globe has been much as it now is from the first, then the north polar regions were the first to be cool enough to support life, and so life probably began in that part of the earth. Paleontologists have found rich fossil bearing rocks of Silurian age beyond 60 degrees north, and the climate was warm enough as late as the Tertiary age to support a rich tropical life. The south polar regions have been covered by water ever since man has left any record, although when the glacial epoch covered all the northern part of the continents with ice, there may have been and probably was a great extension of the land areas in southern latitudes. It is probable, however, that the continents were shaped out much as they now are from the earliest times, and that life began and spread from the greater land surfaces of the north. It is also believed that formerly the land surface extended from the northern part of the American continent eastward by way of Greenland and Iceland, and either connected it with northwestern Europe, or at least much more nearly so than now.

While we find positive fossils only back to the Cambrian rocks, we believe and know that the beginning of life was longer in time before that period than has passed since then. The Laurentian rocks are the oldest that have ever been examined by geologists. These, while highly metamorphosed, contorted and folded, are undoubtedly sedimentary in their origin and were laid down under the ocean. Only a few years ago they were called Azoic, or without life. But one fossil has been described from these rocks, and that is not accepted as a true fossil by all geologists. Prof. J. W. Dawson, of Canada, has described what he believes to be a Foraminifer, one of the lowest forms of marine life. But without this doubtful one, we have abundant evidence of there having been a teeming life in the oceans, where the Laurentian rocks were laid down. There are immense beds of limestone, great deposits of iron ore and rich mines of graphite. These are all possible only through organic life. Limestone is a sedimentary formation, built up of broken and worn shells and corals. Iron is held in solution by the water and is only rendered insoluble and thrown down as a deposit by the chemical action of decaying vegetation. Graphite is only one of the stages through which carbon passes from plant, peat, lignite and coal to graphite. All these mineral beds are thus sure indications of an organic life which existed in the times when these rocks were laid down. It is true that there are, all over the earth, small local beds of limestone that are not of marine or organic origin, and that have been deposited by hot springs or by waters holding lime in solution. Stalactites and stalagmites are examples of such formations. But such lime deposits are never laid down in even, level strata, but in folded and uneven layers. The limestone deposits of the Laurentian system are true marine sedimentary rocks. This formation, the Laurentian, is at least 30,000 feet thick, and was made from still older rocks, which must have been subject to the waves of an ocean more ancient than we can concieve of. All the deposits of this age are found in the northern hemisphere, and most of them very far north. They must have been very much more extensive in area when they became dry land than they now are, for they have furnished most of the materials for the later deposits which lie to the north and south of them.

There may be secrets of life buried beneath the great ice cap of the south polar regions, but if so they can only be discovered by the men of thousands of years in the future.

How did life begin? Those who accept literally the story of creation as given in Genesis, believe that all forms of life sprang suddenly into existence at the command of an infinite, all-wise God; that all were created from the dust of the earth; in other words, that by the

Almighty fiat the inorganic was suddenly changed to the organic. In some way the inorganic must have been changed or developed into the organic. All life, plant or animal, has a body consisting of material derived in some way from earth, air and water. There are in living beings only four principal elements, with small traces of some others. Oxygen, carbon, hydrogen and nitrogen, together with a very little of sulphur and phosphorus, are about all the elements that go to make up life of any kind, from the highest to the lowest. It is probable that carbon is the most prominent substance in the wonderful combination we call protoplasm, which in slow operation and by successive modifications has developed all the teeming life which has since covered the earth and peopled the waters. The protoplasmic cell is the first stage in visible structure, and is apparently very nearly alike for all forms of life from man to the lowest plant. While the change of the inert inorganic matter to the living organic life is constantly going on before our eyes, we may, perhaps, never wrest the secret from nature. By the agency of chlorophyll, the plant is ever changing the inorganic into the organic and building up its cells of living matter. This is a mystery we may never fathom, the production of life from lifeless matter. Prof. Moseley said in Nature, Sept. 3d, 1885: "It was in the littoral region that all the primary branches of the zoological family tree were formed; all terrestrial and deep sea forms have passed through a littoral phase, and amongst the representatives of the littoral fauna the recapitulative history in the form of series of larval conditions is most completely retained."

So far as human knowledge can say, life first began in the shallow waters near the shores of that old Laurentian ocean, far up toward the north pole. Which form of life, plant or animal, was first brought into existence, is not easy to tell with certainty. As we understand the life of today, it would be easy and safe to say that plant life had an existence before animal life, but the surrounding conditions of that immensely distant time may have been so different from any thing we now know that a wider knowledge might materially change our ideas on the subject. The lowest plants and animals are so closely related that it is hard to draw any fast line separating them from each other. But there is this fundamental difference between the two forms of life, which has, however, a very few exceptions, that will be spoken of later. The plant alone has the power of converting lifeless inorganic matter into living organic cells, while the animal cannot do this. So that the manner of obtaining nutriment must make the difference between the two forms of life. All organic life must be supported fundamentally by inorganic material drawn from the earth and atmosphere. The plant alone is able to do this by the aid of what we call chlorophyll, which gives the green color to vegetation. This chlorophyll absorbs certain parts of the sun's rays, which set up a chemical action and separating carbon from the oxygen in the carbonic acid gas in the air, and also hydrogen from the oxygen of the water, thus form hydrocarbons, which are a source of energy. Now if the animal is unable to do this, it must depend upon the plant for its energy, and so we must believe that plant life existed before animal life. This belief is substantiated by the paleontological story of the oldest rocks in which distinct fossils have been found, so they are mostly plant remains.

Some naturalists have contended that the earliest protoplasm did not contain chlorophyll. They contend that chlorophyll is a modification of protoplasmic cells and, therefore, a subsequent acquirement slowly gained. It would seem, however, that plant life must have been first, because life is a product of power operating under its separating action of energy upon matter, and so an energy storing organism must have come first. I have already said that it is difficult to draw a line clearly separating the plant from the animal. There are a few forms of plant life that do not possess chlorophyll, and, therefore, can exist without light. There are also a few of the lowest of the animal forms that do contain chlorophyll and exist in certain conditions. These very few exceptions, however, do not affect the rule which we may state as, life is due to energy received from the rays of the sun, and this energy is powerless without the chlorophyll, therefore protoplasm with the addition of chlorophyll is the necessary basis of all life.

All forms of life begin with the single cell, and may come to maturity as a single cell or as an aggregate of many cells. The lowest organism, having but a single cell, performs all the functions belonging to life. It feels, moves, feeds and reproduces its kind. In the many celled organism these functions are performed by separate cells, independent of each other, yet bound together, and all working in harmony with each other. This separation of function is what causes difference in structure, all the various parts of the plant, all the different parts of the animal are aggregates of the wonderfully minute cells, each modified according to the necessities of the different functions performed. The lowest one-celled forms of life reproduce their kind by fission or simple separation of the one mature being into two immature beings. All forms of life absorb more nutriment before maturity is reached than is required for the present support of life, and so they grow. Waste is less than repair, and when the single-celled animal reaches its full size, the excess of nutriment continuing, the cell separates into two immature beings.

All forms of life above these lowest ones, either plant or animal, have speciallized cells for reproductive purposes. There must be an impregnation of the female germ by the nucleus of the male sperm cell. This process of impregnation is accomplished in a great variety of ways, but difference in detail does not change the general statement. There must be a coming together of the two elements, male and female, in order that species may continue to exist. The low algae, the great elm, the sponge and man are all developed from some sort of a germ, which may be called spore, sac, seed or egg. Each of these myriad species of life, in its development from the single egg cell, passes through and shows the ancestral history of its long descent. The study of embryology makes necessary a theory of evolution of one form or species from another by constant modification. At certain stages of the growth of the embryo of fish, dog or man they are so nearly alike that one cannot be distinguished from another. Von Baer, one of the great students of embryology, is quoted by Darwin as follows: "In my possession are two little embryos in spirits, whose names I have omitted to attach, and at present I am quite unable to say to what class they belong. They may be lizards, or small birds, or very young mammanlia, so complete is the similarity in the mode of formation of the head and trunk in these animals. The extremities, however, are still absent in these embryos. But, even if they had existed, in the earliest stage of their development we should learn nothing, for the feet of lizards and mammals, the wings and feet of birds, no less than the hands and feet of men, all arise from the same fundamental form."

From what has already been said, we can see a development in parallel lines following after each other. The first was begun myriads of ages before the second one, and was a development of the inorganic world. There was a breaking up, a separating of the materials of the rocky crust by the agency of heat and water, and a gathering together of the detritus under new combinations and in new places and conditions to prepare for the organic life, which was, in the future, to come into being. In this development or change of the inorganic materials of our earth, there must have been produced that which is the foundation of all life, from the lowest to the highest, protoplasm. This word is a compound of two Greek words, *protos*, first, and *plasma*, moulded. It is a half-fluid, sticky material full of numberless minute granules, in ceaseless and rapid motion. It is a complex union of the elementary substances, carbon, hydrogen, oxygen and nitrogen. From this protoplasm was developed, when the proper conditions had arrived, the second line of development, organic life, plant life could have been developed and have existed in the seas while their waters were still very much too hot to have supported any kind of animal life. Dana says that in the hot springs on Pluton Creek, Cal., Prof. W. H. Brewer observed confervae in waters of 140° to 149° F., and similar algae in water at 200° temperature. Such a heat as this would be fatal to animal life of any kind.

In the second line of development was animal life also, and that would have begun after plant life, but with a much shorter interval than that which passed before the first plants existed. A little more cooling down below the temperature in which plants could live, and the first animal life must have appeared. Their food was ready for them, and when other conditions were suitable the first beings which could have been called animals came into existence. The change from plant to animal is not wide, as some plants in their immature stage behave like animals, darting through the water by the aid of small filaments and only finally settling down and growing like other plants. Other plant forms never settle down, but are locomotive through life. On the other hand, some marine animals while young are free and movable, but when mature are rooted to one spot, where they live and grow, such as crinoids, corals and sponges. Other organisms are at one stage apparently animals, while at another stage they appear to be plants. The naturalist of long ago said that the stone grew, the plant grew and lived, while the animal grew, lived and moved. Under our present knowledge this definition or description would not be sufficient for some of the lower forms of life.

There is another thing that may be said concerning life at those early times in the earth's development. Life, as we have seen, probably began while the rocks were still so hot as to hold the water at a high temperature. If this was so, we must believe that the evaporation was very much greater then than now, and so the air would have been filled with dense clouds, shutting out a large part of the sunlight which is so necessary to the plant life of the present time. Vegetation in such a condition might have existed without chlorophyll, which is now needed for the sun's chemical action in changing the inorganic material to a suitable form for the living organism. Protoplasm must have existed before chlorophyll, as the latter is a modification of the former. The plant and animal in these lower forms are so nearly alike that Huxley has said, "that the problem whether in a given case an organism is an animal or a plant may be essentially insoluble." We believe that from this first almost indeterminate form of life on our globe, so long ago that we can have no comprehension of the meaning of the words expressing the time, there were two diverging lines of development from which all forms of life, plant or animal, which have since existed, have come. Nature, working with unlimited means, through endless time and space, had by ceaseless, but slow modification, developed all organic beings, one from another. An undeviating, ever acting law of continuity has accomplished all the wonderful works we see about us.

If, as is believed by those who have spent a lifetime in the study of this great and important question, life had its beginning on this earth in its lowest and most simple forms, in the way I have so briefly and inadequately described, then there comes up the not less interesting question, how have all the various forms of life, both plant and animal, arisen that have since covered the land and peopled the sea? The old ideas of the fixity and immutability of species, created suddenly by supernatural fiat, have largely disappeared from among intelligent people everywhere. Near the close of the 18th century, Goethe, in Germany, Erasmus Darwin, in England, and Geoffrey St. Hilaire, in France, gave out their conclusions on this subject that were so far in advance of the age they lived in that they found few believers. From their study and observation, they came to the conclusions that species of all kinds were not, as had hitherto been believed, immutable and unchangeable, but, on the contrary, they were continually changing. Before their time, and even to the present, a belief in the infallibility of the story of creation as told in Genesis has prevented many from even attempting to find any different way of accounting for the innumerable forms of life which have existed since life began, than that set forth in the supposed inspired account of special creation. But the accumulating mass of facts gained by the patient investigations of scientists in all parts of the earth has led to an ever-growing belief that all the different species of plants and animals have descended and been formed from earlier ones by modification. It may be set down as a fact that no two individuals of the same species are ever exactly alike. There is in each a continual tendency to vary. We so frequently hear it said that no two persons are just alike. No two leaves can be found in which a difference cannot be detected. Is it possible for us to learn what causes this difference in two organisms of the same species growing side by side, and apparently surrounded by the same conditions? But first, is the environment ever just the same for any two individuals of the same species, or has it been for the ancestors of those individuals? We have already seen from what has been said before that the inorganic world has been, from its very beginning, subject to continual change, from physical and astronomical causes. Before it had cooled sufficiently so that its climate could have depended at all on the heat derived from the sun, there must have been a constant change going on in its cooling crust. There would have been a constant breaking up of the slowly cooling exterior, caused by the pouring deluges of hot water, thick with mineral and acid solutions, which would act with terrific force in breaking and disintegrating the slowly cooling rocks. That combat of the elements began with the beginning of time on our earth and has continued to the present, although with always diminishing force. Now, having the facts of this ceaseless change in the inorganic world and the constant tendency to variability of the organic life which peoples it, how are these two series of facts connected? The common observation of all people teach them certain facts concerning plants and animals. Here in the north we can raise great crops of apples and cherries, but when we go to Florida we look in vain for an apple or cherry tree, while e find orange and guava trees all about us. There the pineapple grows as readily in the open air as the cabbage does here. There the Palma Christi or castor oil bean grows from year to year into a large tree, while here it is a small shrub, killed by each year's frost. There the mocking bird makes its home all through the year, while here the little English sparrow is as common. The swarming life of those southern oceans is almost entirely different from that of our northern seas. We say, with generally little thought about the matter, that the products of each section of the country are adapted to the soil and climate of the region where we find them. This would seem to establish, as a fact, that no organism can exist except it be in harmony with its environment. Now the organism must change as its environment changes or it will cease to exist. If then physical change takes place in the conditions surrounding a species, then those individuals which may have varied so as to be a little better suited to the new conditions will be more likely to live and transmit such variations to their descendents. Such variations are transmitted and, therefore, tend to become permanent. Every farmer is aware of this fact, and takes advantage of it in the improvement of his stock, whether plant or animal. There frequently appears in the fields of the farmer, in his flocks and herds, or in his garden, some animal or plant different from the others of the same species, and better in some way. These variations, commonly called sports, are frequently used for the propagation of a new variety. Care in cultivation and selection from best fruits has given us all our many varieties of apples from the small sour crab that grows wild. So have all our grains come from wild grasses. All the many varieties of dogs, from the largest to the smallest, have been produced by the careful selection of the best animals for breeding. When we look about and see what wonders man has accomplished by care and selection in the short time since he has had domestic animals, or has cultivated plants, we can begin to understand what nature, with her unlimited time, can do and has done. While man has only worked and selected from external and visible characters, nature has acted on every internal organ, and while man has changed and modified the beings of the organic world for his own pleasure and benefit, nature has worked a far greater change, entirely for the good of the organism. Therefore, nature's changes are far more enduring and true than any that man, in his comparatively short time, has been able to produce.

At our meeting, two weeks ago, we were told of a case of plant reversion, and the case was used as a testimony or argument against the forming of new species from previous ones, or the development of new species by modification of existing ones. This case, to me, seems, on the contrary, to be such good evidence in favor of the theory of the origin of species by modification that I must spend a few moments in considering it. All about us, in this region, there grows wild the plant we call the sunflower. Under the care of nature, and in harmony with the environment furnished by our common mother, this plant grows and thrives. Its blossoms are many to each individual, but they are small, while the seeds are few and imperfect. In its wild state, it is wholly a child of nature, and lives in harmony with its environment. But at one time man took some of the plants and, by care and cultivation, completely changed their appearance, producing at least a different variety. The plant, under the care of man, with its cultivation and more generous nutriment, instead of producing, like the wild ones, many small and less perfect blossoms and imperfect seeds, brought forth one large and perfect blossom and abundance of fertile seeds. In short, surrounded by an artificial environment by the care of man, the plant at once responded by growing in harmony with the more favorable conditions and became very unlike its wild ancestors.

After some years of culture it was neglected and again left to the care of its mother, Nature. At once it began another change, and, growing in harmony with its less favorable surroundings, reverted to the form and condition of its earlier ancestry. Now, in this case, we have positive proof that this plant, with a new and more generous environment, changed itself and lived in harmony with its new and better conditions. When the artificial environment was withdrawn, the plant made another change, and was again in harmony with its surroundings. Now the conditions provided by Nature were not appreciably changed during the short time of this experiment, and the plant naturally reverted to its wild state as soon as the interference of man was withdrawn. Nature, to make the same changes in the surroundings of this plant, might require and take the time of a hundred generations of man, but when the change had been made, it would last, it would endure for an equally long time. That this plant changed twice within a few years in response to changed surroundings is ample proof to convince me that it would also change as much or more under a natural change of environment, and that the change would be permanent while its surroundings were unchanged.

Nature also provides for natural selection and survival of the fittest in another way. That is, by the birth of far more organisms than can possibly survive to maturity and the age of reproduction. Because of this there comes about a struggle for existence between the members of the same species, in which those individuals who may possess any superiority over their fellows have a better chance to live and transmit their superiority to their descendents. Among animals, the elephant is the slowest breeder known, and yet, in the short time of seven hundred and fifty years, if all the progeny of a single pair should survive to maturity, there would be nearly nineteen million living elephants. Man doubles his numbers in about twenty-five years, and, if all had reached maturity, their descendents would fill all the earth as thickly as they could stand in less than ten centuries. Natural selection has been a continually acting force during all the ages of the past, by which the whole organic world has been developed by a choosing of those beings which were nearest in harmony with an ever-changing environment.

Now let us see if we can trace the course of this development, both in plant and animal forms. What does a study of the myriad forms of ancient life, preserved in the rocky leaves of the book of nature, teach us of the condition of the inorganic world at the time in which they lived? If we go into a museum where are gathered together specimens of the handiwork of man for many centuries of the past, we can tell at once what was the civilization of the people whose work we are studying. From the works of man in the highest cultured nations of the present time, back to the relics of man in the rough stone age, there is a long line of specimens that gradually become less beautiful in design, finish and esthetic use, until we reach the rough stone implements, few in number, rude in workmanship and general in use. As man has fought his way up from primitive savagery to cultured civilization, he has continually developed an increasing speciallization. So has it been among the lower plants and animals. Let us study the forms of plant life from the present as far back as we can go and see if they will tell us anything concerning the condition of the inorganic world when they lived. The plant, as we know, derives a large part of its nutriment from the carbonic acid of the air. Its leaves are the organs through which this nutriment is absorbed and assimilated for the building up of the growing organism. Therefore, we should expect to find the leaf surface of the plant proportioned to the amount of carbonic acid in the air by which it was surrounded. An examination of fossil plant remains will show us a continually decreasing leaf surface until, as we go backward in time, leaves will have entirely disappeared. The first plants were without leaves, and the ends of the small branches were mere buds or only rounded off. We know that the necessary condition of existence is, and always has been, that each organism should be in harmony with its surrounding conditions, and, therefore, we are compelled to believe that the supply of plant food must have been very much greater at the beginning of plant life than it now is, and that it has been gradually but surely taken from the air from that time to the present. As matter is indestructible and can only be changed in form, we must ask what has been the cause of this gradual decrease, and where has the excess of carbonic acid gone to. The plant stores up the carbonic acid in the form of carbon, and so builds itself up. Now if a plant dies and decays on the surface of the ground, or is burned, the carbon in it again unites with a certain portion of oxygen, and again becomes carbonic acid. But if the plant is protected from decaying, then it holds on to its carbon. An examination of a piece of mineral coal under the microscope shows us that it is almost entirely composed of plant remains. The immense coal beds found in all parts of the world, answer our question at once as to where the excess of carbonic acid has gone to. There is at present only about four parts of carbonic acid in each ten thousand parts of the atmosphere. A very small increase of this percentage of carbonic acid in the air would be fatal to the highly organized life now existing. Let us now examine the remains of animal life of the past that we have found as fossils and see if they, too, will tell us the same story of the ancient condition of the earth. We very frequently read in the papers of men losing their lives by going down into wells or cisterns which have what is called "bad air" in them, of terrible mine disasters where scores of miners perish because of choke damp. These accidents are all caused by an excess of carbonic acid gas, which, being heavier than air, settles in the bottoms of wells or mines. This teaches us that the animal life now existing cannot be maintained in an atmosphere where the proportion of carbonic acid is very much greater than in the air we breath. In tracing the life of our earth backward we must expect to find a decrease in the number of our present forms of organic animal life, replaced by others lower down in the scale of being. Up to the close of the Carboniferous Age, we find no remains of birds or mammals. The animal life, with the exception of a few insects, was wholly aquatic or amphibian, and a large proportion was marine. Dana says of this period: "During the progress of the carboniferous period there was, then, a using up and storing away of the carbon of the superfluous carbonic acid, and, thereby, a more or less perfect purification of the atmsophere, and a diminution of its density. In early times there was no aerial animal life on the earth, and as late as the Carboniferous period there were only reptiles, myriapods, spiders, insects and pulmonate mollusks. The cold-blooded reptiles, of low order of vital activity correspond with these conditions of the atmosphere. The after ages show an increasing elevation of grade, and variety of type in the living species of the land." If we go back still further in the life history of the earth, as shown by paleontology, we shall find still more proof of the development animal life has passed through because of the changing environment. The first certain fossils are found in the Cambrian rocks. These rocks rest unconformably on the crystalline rocks of the

Laurentian age. All rocks below the Cambrian were only a few years ago called the Azoic, a word which means, without life. Later investigations by geologists have shown convincing proof that these rocks also were laid down in an ocean teeming with life. Beginning with the Cambrian age we find these rocks, in all parts of the world where they have been examined, filled with fossils. For many years this fact was a stumbling block in the way of the theory of evolution which it was difficult for its adherents to explain away. The sudden beginning of such a multitude of life forms in these rocks, while, apparently, there was no life in the formations lying just below, was a puzzle for a long time. But the patient study of scores of students has shown that the seeming absence of life was caused by the metamorphism of the Laurentian rocks, which has destroyed all direct traces of fossils. The Laurentian rocks are immensely greater in age than the Cambrian strata, which rest uncomformably upon them. It is believed that the time since life began was very much longer before the Cambrian period than has passed from that time to the present. In other words, the lifetime on the earth has been more than doubled by these later discoveries. Dana says the Cambrian rocks have furnished no fossils of terrestrial life, all plants and animals were marine. Other authors have claimed a very few uncertain forms of land plants. The plants, with the possible exception noted above, were all of the kind called fucoids, while the animal forms were all invertebrates. There would be nothing strange in the absence of land plants among these fossils, even if they then existed, as these are much less likely to be fossilized and preserved than sea plants. The land plant nearly always grows, dies and decays where its seed first germinates. There would be but few which would fall into the water and be preserved as fossils, while a large part of marine plants would be covered up with sediment, and so preserved from decay. We must, therefore, leave the question yet undecided as to whether there was any land vegetation during the Cambrian period. During the whole of the Silurian age, of which the Cambrian was the lower member, there has as yet been found no forms of land life, if we except a few uncertain plants. The first vertebrates have so far been found near the close of the Upper Silurian age, and these are all fishes. None of them have yet been found in America, but only in Europe. Dana says the first certain land plants have been found in the closing part of the Lower Silurian age, and that the land of the Trenton period had its Ferns and Lycopods. Such fossils as these indicate the possible existence of terrestrial articulates.

The next, or Devonian age, has been called the age of fishes from the abundance of the remains of these animals that have been found in its rocks. During this age, terrestrial plants appear in profusion for the first time. They are of higher orders than any which have been found in rocks of an earlier age. They are Lycopods, or ground pines, Conifers and Ferns.

We next reach the Carboniferous, or coal making age. This age began, both in America and Europe, with a marine period and closed with one. During the middle part of this age were laid down the great beds of coal that are found in all parts of the world. This was truly a time of preparation for the higher life that should appear at a later time. There were two distinct lines of development carried forward together, one caused by the other. The physical condition of the inorganic world was well suited to a wonderful growth of vegetable life. The air was yet heavy with its excess of carbonic acid, thus furnishing the needed nutriment for the wonderful plant life which grew so luxuriantly. The crust of the earth was yet unsettled and its oscillations up and down alternately submerged and then uncovered the land surface. In this way were covered up and preserved the remains of that rank vegetation, to serve us of this later day as coal. These vast deposits thus absorbed and stored up as carbon the excess of carbonic acid and purified the atmosphere, thus making possible higher forms of life.

Geologists have divided the rocky strata of the past into separate ages, for convenience of study and description, and have given them descriptive names. They have called the largest divisions Times, and have named the first one Archean Time. The second grand division is called Paleozoic Time, and extends from the beginning of the Cambrian formation to the close of the Carboniferous period. The third or Mesozoic Time begins with the Triassic period and ends with the Cretaceous. Last comes Cenozoic Time, reaching to the present. The Mesozoic Time, with which we will now spend a few moments, has been named the Reptilian age. It includes and is divided into three periods, the Triassic, Jurassic and Cretaceous. So far in our study of the development of life we have found a gradual but sure elevation in speciallization and character as indicated by the periods. Land plants and animals have appeared, the plants first and then the animals. As fast as suitable conditions were developed in the physical inorganic world, then a higher type of life has made its appearance. We shall find this to be the case all through the geological ages of the world. A change in the geographical form of land and sea has produced a different climate. This has brought about a different plant life, followed by a corresponding change in the animal kingdom. Each has been the effect of previous changes and the cause of following ones. The Mesozoic Time brought into existence a wonderful change in terrestrial life. The first mammals, both marine and land, appeared. The first Birds, the first of the common bony fishes, such as our rivers and lakes are now filled with, are found in deposits of this time. The first Palm trees grew on the land then above the waters. All of our common, well known trees, both forest and fruit, first grew and blossomed in this age. The lack of carbonic acid in the atmosphere compelled the plants to increase their leaf surface, and this same lack of nutriment gave us the slower growing and more solid wooded tree trunks, without which we could not have had our lumber. The animal life was largely aquatic or amphibian, and the seas swarmed with monstrous saurians, which were all carniverous and cold blooded. In the latter part of this time, the Cretaceous period, were laid down the formations of Northwest Iowa, on which the glacial clay or loess was afterwards spread over in the socalled Ice age. All the life of the Mesozoic Time was moving upward and shadowing forth the higher forms of the succeeding, the Tertiary age.

This brings up to Cenozoic Time, when the mammalian fauna predominated over the lower and disappearing reptilian forms. Cenozoic means recent life, and this time has been divided by geologists into two ages, the Tertiary and Quaternary, the former the age af mammals and the latter the age of man. All the great mammals of the Tertiary age are extinct. They were wonderful in number and variety as well as monstrous in size. Nearly all the land animals, from their first appearance, have been vegetable feeders, and through all the time they existed in their age their size increased. The line of development has seemed to be, so far, in bulk or bone and muscle. They were great in bodily size, but had very small brains and were stupid, sluggish and low in intelligence. If one will examine the cuts showing the fossil skulls of these extinct monsters, which are shown in Dana's Manual of Geology, the exceeding smallness of brain in comparison with the size of skull will be very striking. It seems as if nature, in maintaining the harmony between being and environment, had built up the body until the limit, beyond which she could not go in this direction, had been reached. In our civil war I well remember a case in my own regiment which illustrates the difficulty with which organisms of strong body are subject to in changing climate and surrounding conditions, which may make plainer some of the reasons why the monstrous animal forms of the Tertiary age became extinct. Among the companies in the regiment to which I belonged was one from the northern part of my state, Wisconsin. They had been lumbermen at home, and were the finest looking lot of men in the regiment, nearly all over six feet in height, strong and robust in body. But in the camps of a different climate they fell far behind in health and endurance the younger and more frail appearing young men of the cities. The change of climate was much harder for them than for those more immature in age and bodily vigor. So with those great animals of Tertiary times. They could not adapt themselves to the changing conditions of the physical environment, and so perished and became extinct. Not one of those strange and uncouth shaped animals has now anywhere on our earth a home; all became extinct millions of years ago. From the first forms of life back in the dim and mysterious ages of long ago, up through all the intervening ages to the close of the Tertiary age, development was in body, in bone and muscle, and finally reaching its limit, the continuing change of the inorganic world overwhelmed and extinguished nearly all of it.

The sudden changes in organic beings, the apparent destruction of a whole world of life, which we find so many times in the geological ages of the past, is apt to mislead many students who study the past life of our world. We must liken the record which we have on this subject to a book, from which whole chapters in some parts have been torn away, and in other places pages are missing, while in still other parts sentences and words are gone or transposed. If several like books were treated in that way, with the mutilations made at random, it might be a not very difficult matter to gain a knowledge of the whole subject by studying all of them together, and so learning in one what was lacking in another. So it is in our geological record. Leaves missing in one country or section may be found in another and the story thus completed sufficiently for us to understand the most of it. There should be no surprise that our knowledge of the past life history of the earth is so incomplete, that there should be so many missing links. It should be remembered that few land animals are preserved and fossilized, and also that only a small part of the earth's surface has been at all closely examined. This very lack of evidence, and the difficulty of finding it, makes the study of paleontology one of the most intensely interesting pursuits that the student of science can follow.

Near the close of the Cretaceous period a new order of terrestrial beings are first found. From this order, or with it, was later to be developed the highest form of life which has thus far had a home on this earth, an order that should be above and rule all other beings of this world. A new era has dawned, the era of brain. Muscle and bone has been carried to the extreme limit and proved insufficient. Brain must now take the place of giant body in nature's evolutionary workshop. In the operation of natural selection a point was reached where great size of body could aid no further, and increased intelligence was demanded, so that individuals of the highest order might learn from experience instead of depending upon instinct alone. The great size of the vegetable feeding animals made them unable to adapt themselves to the physical changes going on in the world and, therefore, they perished and became extinct. It has been well said that the animal is the creature of environment, but that man is the creator of environment. The first of the order of Primates, to which man belongs, who have left any remains that have been discovered, lived in the forests which grew in the closing time of the Cretaceous period. The first remains of monkeys are found in these deposits. Evolutionists do not believe that man is the descendant of the monkeys any more than that monkeys are the descendents of man. Back in geological time, somewhere, it is believed that there was a separation by development of two lines of animal life from some unknown form, from one of which has descended all the monkeys, apes and allied animals, while from the other has come all the races and varieties of the human family. Nature has expended her skill in the development and perfecting of man as a single family, a single genera and a single species. While there are many varieties of the human race, there is but a single species. The other branch of the order of Primates, of the monkey family, has spread and developed into many genera and species. In studying this development of brain, let us take up as far as we can man in his upward course from the animal. If we go back and down in the history of man, we shall pass from the intelligence of the most highly civilized and cultivated nations to races lower in grade until we shall reach the savage, but little above the brute in brain force, and there our written or traditional history must close. This will take us back only a few thousand years in time, which is almost nothing in comparison with the immense length of time we believe man has been upon the earth. The earliest record of the presence of man that we can find is told to us by the scattered specimens of his work that we find in the gravel deposits at the close of the glacial epoch. He had then risen far enough above his brute associates so that he knew how to make simple weapons and tools from the hard flinty rocks that he found about him. What was his condition and development from his first appearance up to where he has left his works behind him, we must surmise and judge as well as we can. He was probably, at first, simply a biped animal, having a brain of more force and acuteness than had the animals by which he was surrounded. For many thousands of years before the beginning of the most ancient civilizations, men were but savages of the lowest type. They warred with their enemies and competitors. Beings less strong and cunning than themselves became their prey. Like the animals, they were born, grew and died during countless generations, in company with the mammoth, the urus, and other extinct species of the brute kingdom, similar in life, and only equal in all moral relations to their four-footed neighbors. The stream of evolution bore man, like other species, forward in its current, and he neither knew nor thought of what he was or where he was bound. Finally his more active brain brought him to invent the rudiments of a language. This could not, at first, have been much in advance of the inarticulate cries of other animals, but gradually grew in distinctness as his increasing thought and intelligence asserted itself. His first weapon, the stick or stone, which he picked up as did the monkey or ape, became selected and chosen for its fitness for his use. Nature furnished him with fire and, like other animals, he was at first probably afraid of it, but finally learned that by its use he could warm himself in cold or chilly days and nights. Long afterwards he learned that by its use he could soften his food, open his shellfish or bake the hard nuts he ate. Can you imagine the condition of the human race if all knowledge of the use of fire was suddenly lost? We depend so directly upon its use in such a multitude of ways and are so accustomed to all of its benefits that I believe none of us can place ourselves, in imagination, in a condition or among a people who have never known its use. Parent of nearly all the arts, civilization and culture would not have been possible without it. We should be much more helpless, if deprived of it, than Primitive man was, because luxuries or advantages which have never been known are not missed. When our first ancestors, naked savages, wandered over the earth, seeking and finding only a bare subsistence, all the natural means of our later progress and culture were already present and waiting for human intelligence to make use of them. Condensed sunshine of Carboniferous days, in the form of coal, was locked up and preserved in thick beds all over the world. But to the savage it was only black and useless stones and rocks. Hills and mountains of iron ore were piled up everywhere, over which he wandered in search of the game or roots he ate. Coal and iron ore, without the aid of fire, are only a useless part of the rocky crust of our earth. Fire must join these two hard and inert substances of civilization and progress. By this union has since come the grand work of forges, foundries and shops in all the world of the present time. By the help of this union of coal and iron we have bridged the oceans with our mighty moving steamships, and our trains of palace and freight cars follow their shining way across the continents. This has been a long slow development, and it took thousands of generations to teach primitive man the very beginnings of such knowledge. He struggled along through centuries in his slow progress of evolution. We must believe that evolution included man as well as all other beings and was universal in its work, or the theory becomes entirely worthless. As an arch, no matter how skillfully and perfectly made, cannot stand unless it be complete, so evolution, if it excepts man, will fall from its own weight. He who professes to accept the theory of evolution and development through all nature, both inorganic and organic, up to man, and then requires a supernatural interference of creating power to account for himself, is either inconsistent or ignorant of that which he professes to believe. If there is anything in man, any faculty that is outside the range of causation, then the theory of evolution is of no value, and we are all mistaken in our belief. Prof. Huxley has said: "Structure for structure, down to the minutest microscopical details, the eye, the ear, the olfactory organs, the nerves, the spinal cord, the brain of an ape or a dog, correspond with the same organs in the human subject." Is the one the product of evolutionary development, while the other has needed the special creative fiat of the same infinite intelligence which planned the growth of the first? I cannot believe anything so inconsistent as this. But the skeptics of evolution say to us, where are the "missing links" showing all these changes from moner to man? Show us the fossil monkey-man or man-ape; give us a sign that we may believe. They do not know that in their own bodies have been already given all the connecting links from the lowest form of life, up to and including man himself. Standing forth like milestones, on the road of evolution, over which all organic life has moved, have been the changes and modifications in their own physical bodies. Beginning life in the single cell, as all other living organisms do, do they become man at once? Certainly not. We must all pass through changes and modifications showing the steps by which we have ascended from the lower to the last and highest form so far seen on our earth. At first, the single cell that is to become man, divides by simple fission into two cells. Here the amoeba stops, but man must go farther. He has, successively, the forms of lower life of past time, is sponge, worm, fish, reptile, monkey and ape, before he takes his final form and we say a man child is born to us.

If we go back to the egg from which man is developed, we shall find it only about one one hundred and twenty-fifth of an inch in diameter, and yet, within this exceedingly small space is compressed the results of millions of years of development. Heredity has already marked out and determined the being that shall come from that seemingly simple mass of protoplasm. Let us follow the series of changes through which this embryo of man passes during its unfolding and development. At first it divides into two cells, as does the amoeba; then it takes successively the sponge form, and then differentiation changes it to and gives it the organs of a worm. Later it has gill slits on each side of its neck with arteries leading to its gills, and it has become fish-like. Then these slits are closed and replaced by membranes like those which supersede gills in birds and reptiles. It has a movable tail at the end of its backbone, longer than its lower limbs. When its feet are first developed the great toe is opposable to the other toes, as the thumb is to the fingers on the hand, and we recognize the climbing-monkey; when it is six months old its body is entirely covered with thick hair, except on the palms of the hands and the soles of the feet. Is there not in all these changes, through which we have all passed, an indication, a review of all the evolutionary changes through which living beings have passed before? I cannot understand it in any other way.

Now, just a few words as to the operation of instinct in the animal and reason in the man in the perpetuation of species. In all living beings we find the structure and instinct of the young when combined with that of the parent just sufficient to give all needed chances for the young generation to reach maturity so that the race shall be preserved. That is, these elements are supplementary to each other. In the lower orders of life, where instinct alone is given to the young, and when parent and young never see each other, instinct alone is not sufficient for the survival of all, and so the number of individuals from a single birth is increased. As we ascend in the order of being, where instinct may be combined with experience of both young and parent, the number of individuals becomes less. When we reach the highest order, man, where reason is added to instinct, and the young are able to profit by the past experience of the race through the mother, then instinct is reduced to its lowest term. The instinct of the human infant is least of all the animals, but it is continually supplemented and helped by the care of the mother guided by reason and the experience of the race. The codfish produces each year more than a million of eggs, and the young are guided in their future life entirely by instinct, never knowing a parent. Not more than one in a hundred thousand ever reach maturity. The young of the human race will not average more than two to each family, of which, possibly, one may reach maturity, and this is only possible by reason of the care of the parents extending over a long series of years. The instinct of the child, combined with the instinct and reason of the parent, is just sufficient to secure the perpetuation of the human race, as that of the fish is only enough to insure the continuation of that race. In the fish, instinct is large and without reason; in the child, there is little instinct and great reason, but at first the reason is in the parent.

In this paper I have tried to show and trace out, as well as I could, the progress and direction of evolution on our earth, as shown in its threefold or parallel lines. Herbert Spencer and other great students believe that evolution moves in cycles; that our universe has had its birth, its growth, and will have its decadence and dissolution when all parts will be returned to cosmical dust, from which it came. It seems clear to me that from the beginning of the present cycle, millions, and, perhaps, billions of years ago, there has been an unbroken continuity of progress from nebulous potentiality to our present system of sun, planets and satellites; from cosmic dust to our earth with its teeming life of plant and animal. I am compelled to believe that our universe, with its wheeling orbs, some of them, probably clothed with life and beauty, as our earth is, has been the result of one unchangeable, eternal and universal law, and that behind, beyond and over it all, has been and is an infinite and eternal energy, the great inscrutable Spirit Power. Possibly in the future there may be modes of being of which we now can have no conception; there may be mind as much above and beyond our comprehension as the mind of a Spencer would be beyond the comprehension of a savage.

Herbert Spencer says in the closing sentence of his Synthetic Philosophy: "The ultimate man will be one whose private requirements coincide with public ones. He will be that manner of man who, in spontaneously fulfilling his own nature incidentally performs the functions of a social unit, and yet is only enabled so to fulfill his own nature by all others doing the like."

BIBLIOGRAPHY OF SIOUX CITY AUTHORS.

II.

By F. H. GARVER.

Two years ago the writer prepared a list of Sioux City authors and their works. It was published in Volume I of these proceedings. The plan followed was to note all histories, novels, short stories, essays, addresses, sermons or poems which had been published in book, magazine or pamphlet form. Works privately printed were not excluded. The names included were either those of actual residents of Sioux City or of persons born and raised here.

The first list was necessarily incomplete, but a beginning was made. Its publication brought to light new names and productions. The present list includes, therefore, not only the publications of the last two years, but, in addition, several names and works omitted from the first list.

In the April, 1905, issue of the Iowa Journal of History and Politics a reviewer of Volume I of these proceedings said: "The article giving a list of Sioux City authors will be of special interest to collectors of Iowana as well as to librarians and bibliographers. It would be well for other communities to follow the compiler's lead and have similar lists made."

If such a list has any value it goes without saying that, the more complete it is the greater will be its value; hence this second list. Sometime in the future the list may be continued still farther.

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