JAMES DWIGHT DANA.

BY MARCUS BENJAMIN.

The first distinct beginning of the science of mineralogy in the United States is referred back by Prof. Geo. J. Brush to an association formed in the city of New York, which assumed, as they expressed it, "the name and title of the American Mineralogical Society." Some years later, the elder Silliman writes that in 1803 "it was a matter of extreme difficulty to obtain, among ourselves, even the names of the most common stones and minerals."

The most important of the early American mineralogists was Dr. Archibald Bruce, of New York city, a graduate of Columbia College in 1797, and of medicine at the University of Edinburgh in 1800. Dr. Bruce established in his native city, in 1810, the *American Mineralogical Journal*, the first purely scientific periodical ever published in America.

Meanwhile, Col. George Gibbs, a young man of wealth, returned from Europe in 1805 with the first extensive and valuable collection of minerals ever brought to the United States. He early formed a friendship with Prof. Silliman, who had been elected to the chair of chemistry and natural history at Yale College in 1802, and proposed during the winter of 1809–10 to open his cabinet, consisting of upward of 20,000 specimens, provided that the college would fit up rooms for its reception. This collection, owing to the unsettled condition of the United States on account of the difficulty with England at that time, was not exhibited until a few years later. It at once gave a powerful impetus to science throughout the land, and was visited by travelers from every part of the Union. In 1825 it became the property of Yale College.

Such was the condition of this new science when the subject of our sketch was born. To him probably more than to any one single individual in the United States is the subsequent development of American mineralogy due.

James Dwight Dana was born in Utica, Oneida County, N. Y., on February 12, 1813. His early life was spent at home, and his first studies were made at school in Utica. At the age of seventeen, he was attracted to New Haven by the reputation of the elder Silliman, who at that time stood foremost among American scientists, and whose influence toward the advancement of science was felt throughout the entire country.

In the autumn of 1830 he entered Yale, and was graduated three years later. During his career in college he showed a special fondness for the natural sciences, however, without neglecting the languages or mathematics; indeed, in the latter branch he distinguished himself.

Soon after graduating, he received the appointment of teacher of mathematics to midshipmen in the United States Navy. During the two years which he held this office he visited the seaports of France, Italy, Greece, and Turkey while on the war vessels Delaware and United States.

In 1835 he returned to New Haven and became assistant in chemistry to Prof Silliman, succeeding Prof. Oliver P. Hubbard,* who then became professor of chemistry in Dartmouth College. He was engaged at this time in the preparation of his "Treatise on Mineralogy," the first edition of which, an octavo volume of 452 pages, was published in 1837.

In December, 1836, he was appointed mineralogist and geologist of the United States exploring expedition then about to be sent by the national government to the Southern and Pacific oceans, under the command of Captain Charles Wilkes. This expedition, consisting of five vessels and a store ship, sailed from Norfolk, Va., on August 18, 1838, with Mr. Dana on board of the Peacock, and visited Madeira, the Cape Verde Islands, Rio de Janerio, Terra del Fuego, Valparaiso, Callao, the Paumotou group, Tahiti, the Samoan group, Wallis Island, and Sydney in New South Wales. Leaving the latter port in December, 1839, important discoveries were made in the Antarctic regions, and during 1840 the Feejee group of islands were explored, the Hawaiian island visited, including the celebrated volcano of Mauna Loa.

In 1841 the northwest coast of North America was visited, and the mouths of the Sacramento and Columbia rivers examined, at the latter of which the Peacock was wrecked. Finally, on November 1, 1841, the expedition left San Francisco for home by way of Manila, Sooloo, Borneo, Singapore, Cape of Good Hope, and St. Helena, reaching New York on June 10, 1842, after having entirely circumnavigated the globe. Besides the mineralogy and geology of the expedition, Mr. Dana had under his supervision the zoological department, including the crustacea and corals. The rare opportunities which this voyage afforded for scientific observation had been well improved, and for thirteen years after his return he was engaged principally in studying the material that he had collected, making drawings, and preparing the reports for publication.

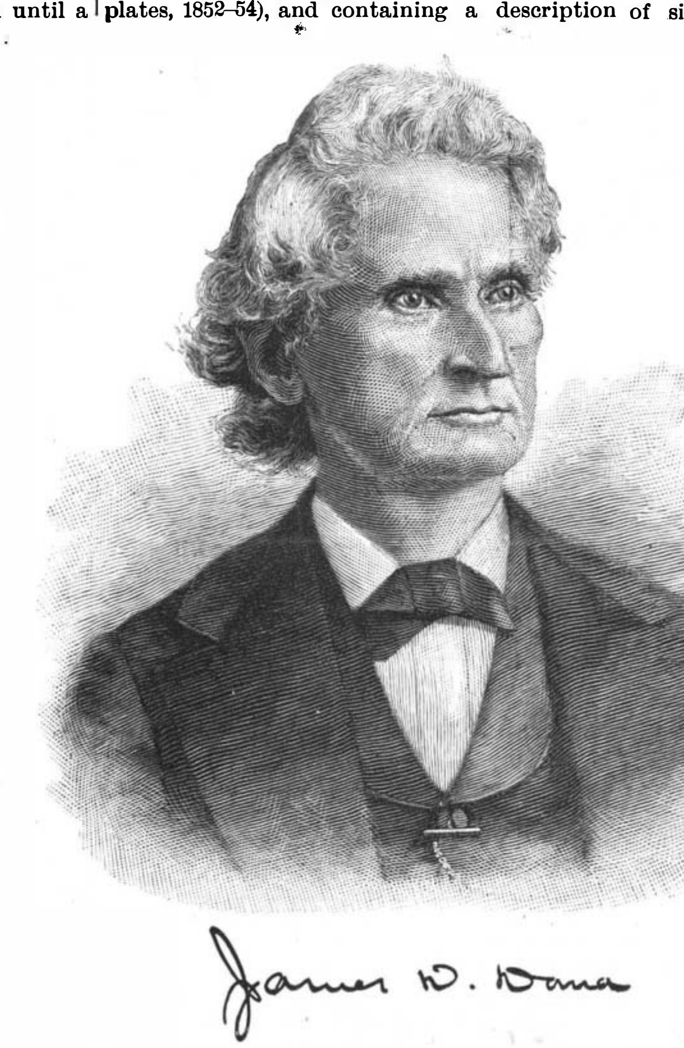
*It is interesting to note that these gentlemen subsequently became brothers-in-law.

From 1842 till 1844 he resided in Washington, and then removed to New Haven, where, soon after, he married Henrietta Frances, third daughter of Prof. Silliman, and has since continued to reside.

The results of his labors are given in three quarto volumes published by the government, of which but 100 copies of each were issued. The first volume was his "Report on Zoophytes" (740 pages, with an atlas of 61 folio plates, Washington, 1846), and in this work Mr. Dana reviewed the whole department of polyps, combining his own observations with those of earlier authors, and proposed a new classification, bringing for the first time the actiniæ and the alcyonoid polyps into their true relation to the astræoid polyps. He also described two hundred and thirty new species in this volume.

The second of the series was the "Report on the Geology of the Pacific" (756 pages, with an atlas of 21 plates, 1849), and gave a description of the geology of parts of Australia, western America, and the islands of the Pacific; also treating at length, with original views, on volcanic phenomena, coral reefs, and the general features of the globe.

The final volume, in two parts, was his "Report on Crustacea" (1,620 pages, with an atlas of 96 folio plates, 1852–54), and containing a description of six



hundred and eighty species, of which all but twenty-two were new. Special attention was devoted to the subjects of classification and geographical distribution in this last work. With few exceptions, the drawings in these atlases were made by Mr. Dana himself.

In 1850, Mr. Dana was appointed Silliman professor of natural history and geology, succeeding his father-in-law, but did not enter on the active administration of the chair until 1856. Prof. Silliman, referring to this event in his memoirs,* writes: "It is a signal favor that I have lived to see my two extensive departments divided, and, without any influence of mine, my own son (Benjamin Silliman, Jr.) charged with chemistry, and my son-in-law with the mineralogy and geology; and I am still in health of body and mind to enjoy this happy result." The subsequent delivery of the lectures n natural history by others led to a change in the title of the professorship, in 1864, to that of geology and mineralogy, and these branches are still in charge of Prof. Dana.

About the time of his appointment as professor, Mr. Dana became associated in the editorship of the *American Journal of Science and Arts*, established by Benjamin Silliman in 1818, and subsequent to the death of its founder he became its senior editor, and now, in conjunction with his son, Edward S. Dana, continues its publication. This journal, at present in its one hundred and thirty-third volume, is well known as the oldest American scientific journal now in existence, and is the great repository of the scientific labors of American investigators.

Contemporaneous with his duties as a lecturer and editor, Prof. Dana prepared his well-known text-books on mineralogy and geology. His "System of Mineralogy," originally published in New Haven in 1837, has grown from a single volume of 452 pages, through successive editions, until the fifth revision, issued in New York in 1868, contains 886 pages. The "Manual of Mineralogy," which first appeared in New Haven in 1851, is now in its fourth edition. Prof. Dana's "Manual of Geology," published in Philadelphia in 1863, reached its third revised edition in New York in 1880, and his "Text-Book of Geology," originally issued in Philadelphia in 1864, has been revised four times, the last in 1883. These four books are recognized as standards throughout the world, and are used as text-books and works of reference wherever the sciences of which they treat are taught in the English language. Soon after his return from the exploring expedition, he published a book entitled, "Coral Reefs and Islands" (New York, 1853), which was a reprint of a chapter from his official report on this subject to the government. A second edition of that book appeared in 1872, as "Corals and Coral Islands." He is accepted as authority on this subject, and one of his latest published papers is on the "Origin of Coral Reefs and Islands."* Prof. Dana's most recent publication in book form is "The Geological Story Briefly Told" (New York, 1875).

* "Life of Benjamin Silliman." By George P. Fisher. Vol. ii., p. 238. New York, 1866.

His separate papers include hundreds of titles, and according to President Daniel C. Gilman, of the Johns Hopkins University, "are probably unsurpassed in extent and value by those of any American philosopher." Of these a series of four articles, entitled "Science and the Bible," appeared in the "Bibliotheca Sacra" in 1856–57, and were called forth by a work of Prof. Taylor Lewis on the "Six Days of Creation," and at the time of their publication excited considerable interest. It is proper to mention in this connection that Prof. Dana is an orthodox member of the Congregational Church in New Haven, and does not altogether accept the Darwinian hypothesis. In all matters of advanced scientific thought he is exceedingly conservative.

Honors have come to him. The degree of Ph.D. was conferred on him in 1872, at the fourth centennial celebration of the University of Munich, and in 1886, at the Harvard celebration, he received an LL.D., a similar degree from Amherst College having been bestowed on him in 1853. The Geological Society of London conferred on him its Wollaston medal in 1872, and in 1877 he received the Copley gold medal from the Royal Society of London. He is a member of the American Academy of Sciences and Arts in Boston, of the Philadelphia Academy of Natural Sciences, and of the New York Academy of Sciences. He was one of the original members of the National Academy of Sciences, and has been a member of many of its important committees. Prof. Dana is a member of the Royal Society of London, the Royal Academy of the Lincei in Rome, the Institute of France, the Royal Academies of Science in Berlin, Munich, St. Petersburg, and Vienna. In 1854 he was elected president of the American Association, and in August of the following year delivered his retiring address at the Providence meeting. His shorter papers have appeared, in addition to the sources mentioned, in the "Proceedings of the American Academy," "Transactions of the Lyceum of Natural History of New York," and in the "Proceedings of the Academy of Natural Sciences of Philadelphia." It has been well said that "Prof. Dana combines with the habit of close and accurate observation powers of mind which place him in the very foremost rank of philosophic naturalists."

No sketch of Prof. Dana as a scientist would be altogether complete without some reference to his son, who so ably follows in his footsteps.

Edward Salisbury Dana was born in New Haven, Conn., on November 16, 1849. He was graduated at Yale in 1870, and six years later received the degree of Ph.D. from his alma mater, having meanwhile, however, studied abroad at the Universities of Heidelberg and Vienna.

In 1874 he was appointed tutor of mathematics at Yale, and in 1879 elected assistant professor of natural philosophy and astronomy. Soon after his return from Europe, he became associated with his father in the editorial work of the *American Journal of Science*, and at present is part owner of that journal.

Dr. Dana's great specialties are mineralogy and crystallography, in both of which subjects he has few, if any, equals in the United States.

In 1874 he was appointed curator of the mineral cabinet of the Peabody Museum of Yale University, and in 1885 was elected a trustee of the institution. He is already a member of various scientific societies, and in

* *American Journal of Science*, August and September, 1885.

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1884 was elected to membership in the National Academy of Sciences.

Besides frequent memoirs on mineralogical and kindred subjects contributed to scientific journals in the United States and Europe, he has published "Appendix II." (1875) and "Appendix III." (1883) of Dana's "System of Mineralogy" (New York); "Text-Book of Mineralogy" (1877, and revised edition 1883); and "Text-Book of Mechanics" (1881).

The Retirement of Professor Tyndall.

Prof. Tyndall has presented his resignation to the managers of the Royal Institution, and it has been accepted with expressions of sincere regret. His age hardly furnishes a justification, as he is only sixty-seven years old. In his letter of resignation he assigned the uncertainty of his health as the cause of his retirement, stating that it would be unjust to permit the fortunes of the Institution to depend on the caprices of his health. He stated that he was so fully prepared to go on with his work that he had made arrangements to go to Paris and purchase apparatus, when he was suddenly seized with an attack of intense sleeplessness. While anticipating full and complete recovery, he felt it his duty to resign. In June, 1853, he received his appointment as professor of natural philosophy in the Institution, and in 1867, a year after the death of Michael Faraday, he succeeded him as its superintendent. His work has taken largely the direction of the popularization of science. His original investigations, while of interest and value, were not as extensive relatively as was his work in other fields. Thus his books on science have had almost phenomenal success, while as a lecturer he was, as regards his audiences, almost without a rival. His lecture tour in this country in 1872 will be remembered by many, and his generous donation of its results, $13,000, to the establishment of a fund for promotion of the study of the natural sciences in America, will ever entitle him to the regard of our people. He acted frequently as the assistant of Faraday. The latter in 1813 had been appointed assistant to Sir Humphry Davy, then professor of chemistry in the recently founded Royal Institution. This was Faraday's first connection with the Institution, over which he ultimately presided. Thus Tyndall forms the last link in the unbroken chain. His successor will do well if he can sustain the reputation of the chair hitherto so ably filled.

As a mountain climber, Prof. Tyndall won renown also, his ascent of the Matterhorn in 1868, preceded by his ascent of the Weisshorn seven years earlier, being achievements of high merit. For many years he annually visited the Alps. He became connected with the Trinity House in 1866, and has done some excellent work in the investigations demanded by lighthouse service, such as the "transparency" of the atmosphere, foggy and clear, to different sounds, such as bells and the steam siren. On retiring he has refused to accept any pension. The directors have requested him to sit for a marble bust to be preserved in the halls of the Institution, have appointed him honorary professor, a title previously borne by Sir Humphry Davy and Prof. Brande, and have decided that one of the annual course of lectures shall be termed the Tyndall course in his honor. Lord Rayleigh was nominated as his successor, the election to take place on May 9. His appointment to the chair will confer on it additional luster, as this eminent physicist may be safely ranked with two or three others as the foremost of the profession.

Plates for Wimshurst's Machine.

My method of piercing these machines is as follows: A disk of iron, 3 in. diam. and ¼ in. thick, with a hole in the center, of the size required in the plates, is cemented to the center of a circular glass plate by softened glass pitch (ordinary pitch with a little turpentine added while warm), the glass and the iron disk being previously warmed. When quite cold, the plate, with the disk attached, is immersed in water to prevent vibration, while the center is broken through, first by driving the tang end of a file through in several places, and afterward by nibbling the glass away with a small hammer until the hole is of the right size. This hole can then be smoothed by a file or a piece of grindstone. The iron disk is now to be detached by a gentle heat to soften the pitch, and the glass cleaned with a little turpentine on a piece of rag. I can do five plates in one hour by this process, and recommend amateurs to try it.—*C. A. Lowe, in English Mechanic.*

A COMMON trouble with us all is that we fail in our business because we think little of it. No man truly succeeds in any calling who has a poor opinion of it. No man has a good opinion of his business who uses it only to make money out of it. No man can have the best conception of his business who does not esteem it for its usefulness. And the higher we go—if "higher" and "lower" are proper terms to use in considering the different honorable and useful walks of life—the more clearly will it appear that he who only esteems his business for the living or money that is in it must, if judged by any high standard, be a failure.—*Dr. Hapgood.*

SCIENCE IN TOYS.

X.

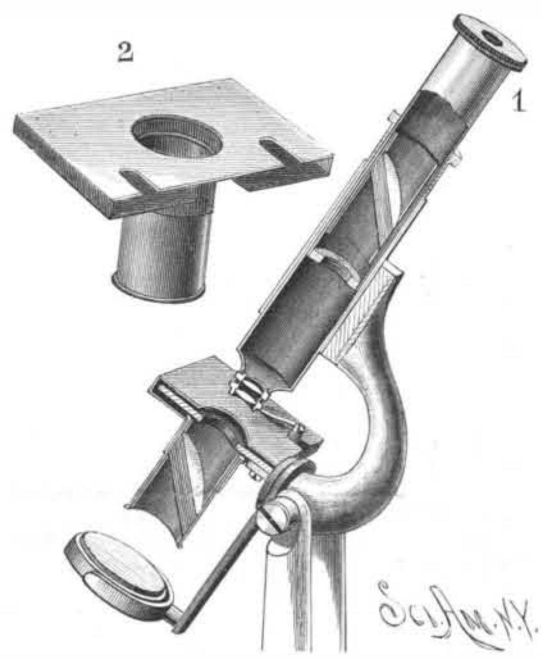
SIMPLE POLARISCOPE FOR THE TOY MICROSCOPE.

The possessor of an inexpensive microscope like that shown and described on page 246 of the current volume of the SCIENTIFIC AMERICAN, or, in fact, of any other microscope not provided with a polariscope, will feel well repaid for his labor if he will construct and apply to his instrument a polariscope like that shown in the annexed engraving. The cash outlay for the material is 25 or 30 cents, and only an hour or so of time is required to complete the attachment.

To the draw tube of the microscope is fitted a paper tube, which is readily made by gumming writing paper and winding it around a cylindrical stick of the proper size. To the paper tube is fitted a second tube, and this last tube is cut diagonally through the center at an angle of 35° 25′. One of these pieces is inserted in the first tube, and sixteen or eighteen elliptical glass covers, such as are used for covering mounted microscopic objects, are placed on the diagonally cut end of the inner tube.

The glasses should be thoroughly cleaned, and when in position in the tube they are held by the remainder of the diagonally cut tube. The sectional view of the instrument clearly shows the position of these glasses in the draw tube.

The tube which goes under the stage is made in precisely the same way, and is supported in position for



SIMPLE POLARISCOPE FOR THE MICROSCOPE.

use by a short paper tube secured to a cardboard casing adapted to slide over the stage of the microscope, as shown in the engraving. Notches are formed in the rear edge of the upper part of the casing to allow it to slip by the slide-holding clips, as shown in Fig. 1. The lower tube must be capable of turning in the short fixed tube, and it may be prevented from falling out by gluing a cardboard band or a piece of small cord around its upper end, forming a sort of flange. The hole in the upper part of the casing is made larger than the movable tube, to admit of inserting the tube from the top of the casing. The part of the attachment below the stage is the polarizer. The part in the draw tube is the analyzer.

By turning the polarizer, the light being thrown directly up the tube by the mirror, the field of the microscope will appear alternately light and dark, showing the partial extinguishment of the polarized beam twice during each revolution of the polarizer.

When the field is darkest, a piece of mica of the proper thickness inserted between the stage and objective renders the field light, and it may produce a color effect, in addition to its depolarizing effect. The colors depend on the thickness of the film or upon its position in the instrument.

There are various chemical salts and animal and vegetable substances which produce brilliant color effects in the polarized beam. Salicine is a favorite. Santonine is good. Tartaric acid, boracic acid, and cane sugar are easily prepared by allowing their solutions to crystallize on the glass slip. Some of these substances, salicine for example, may be fused upon the slip and recrystallized.

The colors may be heightened by placing a film of mica behind the object during examination. Different colors will be produced by different thicknesses of mica.

Among animal substances to be examined in this way are fish scales, parings of the finger nails and of horses' hoofs, parings of corns and of horn.

Among vegetable substances, the sections of some woods, the cuticle of plants, the rush for example, form good polariscope objects.

Many minerals show well in polarized light, but they are generally difficult of preparation. Selenite is an exception. It may be readily reduced to the proper thickness to secure brilliant effects.

The polariscope above described, although not as desirable as one provided with a pair of Nicol prisms, is nevertheless worth having, and will give its possessor a great deal of satisfaction. G. M. H.

The Value of Water Gas in Heating and Smelting Operations.

In a recent number of *Dingler's Polytechnisches Journal* are given the results of some interesting experiments carried out at Frankfort-on-the-Main with the object of testing the value of water gas for heating and smelting purposes. It was found that this gas, made in a Wilson generator, and having the following percentage composition: Carbonic oxide, 18; hydrogen, 10; nitrogen, 68; carbonic acid, 4; was serviceable for the heating of boilers, but unfit for smelting purposes. The melting temperature of silver could hardly be reached, the gas having lost its generating temperature of 400° C. by the transit from the generator to the furnace. By utilizing this temperature and heating the air of combustion, the ordinary smelting operations could be performed; nevertheless, the use of the Wilson generator was discontinued, because the gas was not cheaper than other fuel for boiler heating.

Since 1885 the refining works at Frankfort have used water gas, furnished by the neighboring gas works at 6 pfennige per cubic meter, or about 1s. 8d. per 1,000 cubic feet. It is not stated by what process the gas is manufactured; but in composition it is identical with the Lowe gas. It is still too expensive for all crude purposes, so that it is only used in melting gold, silver, and their alloys, fluxes, and pigments for the decoration of china, and all purely laboratory work. It was compared with the rich illuminating gas obtained from the Frankfort works, and the poorer gas supplied in the city, the burners used being identical. A copper vessel, filled with water, was heated from 15° to 100° C., under similar conditions. It took 10 cubic meters of water gas against 4 cubic meters of Frankfort rich gas, and 5 cubic meters of the poorer gas. Equal weights of two kinds of flux for enameling colors were melted under identical conditions, in a Perot furnace. The cost of the gas in each operation was 4·60 and 6·50 marks for water gas, against 19·6 and 26·8 marks for the rich Frankfort gas.

Equal quantities of fine silver and copper were melted with the two gases in the same furnace. It required of water gas 4·30 and 5·70 marks' worth, and of rich illuminating gas 16·7 and 21·7 marks' worth. By using water gas, therefore, all boiling, heating, or evaporating operations can be accomplished for half the money, and all melting for about a quarter the money, as compared with illuminating gas. It will be seen that this is only the result of the difference in the price of the two gases; for from the first experiment it follows that the pyrometric value of the coal gas is 2·5 times as high as that of the water gas.

A Chemical Entertainment.

A correspondent of the *Chemist and Druggist* says he "was asked to entertain a number of school children with chemical amusements, and chose out of the list such as were most suitable for public exhibition. Others were suggested by what I read. It may save some of your readers time and trouble, when looking up similar work, if I give a list of what were found feasible and successful in my own case:

The Magician's Kettle, which supplied twelve liquors of different color. Of course, the coloring agents were in the glasses—aqua pura in the kettle.

Witch's Caldron.—S. v. meth. with boric acid; stront. nit., etc., in suitable vessels.

Blazing Ice.—Potassium and ice.

Lighting a Candle with Ice.—Put a piece of potassium in the wick.

Fire under Water.—Phosphorus, pot. chlor., and acid sulph.

Dancing Fire Ball.—Charcoal ball on pot. chlor., fused in test tube.

Lightning.—Lycopodium blown into a flame by insect powder bellows.

Ice Creams.—Silicate of soda and chloride of calcium.

Sunlight.—Magnesium ribbon burning in oxygen.

Moonlight.—Phosphorus in oxygen.

Will-o'-the-Wisp.—Phosphorized ether in hot water.

Turning Steel into Copper.—Dipping boy's knife into sol. cup. sulph.

Volcanoes.—Pot. chlor. and sugar, inflamed with ac. sulph.

In addition to these experiments, a gas factory was in work, by making hydrogen, passing it through benzine, and igniting. A lead tree was "planted," and grew. But the most captivating of all was the *Magic Likeness Taker.* Comic figures were drawn on white paper with gallic acid and mucilage. The sheets, apparently clean and untouched, were hung up, and the pictures developed by spraying on them a solution of iron sulphate.

All these may be carried out by any chemist at very little expense."

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