to-day, but for to-morrow. He is well aware that he is still surrounded by too many "men of yesterday," who delay the results of his work.

Sometimes, however, he may feel discouraged that the very efficiency he has succeeded in reaching at the cost of so many painstaking efforts, in the economical production of such an article of endlessly possible uses, as Portland Cement, is hopelessly lost many times over and over again, by the inefficiency, waste and graft of middlemen and political contractors, by the time it gets on our public roads, or in our public buildings. Sometimes the chaos of ignorant brutal waste which surrounds him everywhere may try his patience. Then again, he has a vision that he is planting a tree which will blossom for his children and will bear fruit for his grandchildren.

In the meantime, industrial chemistry, like all other applications of science, has gradually called into the world an increasing number of men of newer tendencies, men who bear in mind the future rather than the past, who have acquired the habit of thinking by well-established facts, instead of by words, of aiming at efficiency instead of striking haphazard at ill-defined purposes. Our various engineering schools, our universities, are turning them out in ever increasing numbers, and better and better prepared for their work. Their very training has fitted them out to become the most broad-minded progressive citizens.

However, their sphere of action, until now, seldom goes beyond that of private technical enterprises for private gain. And yet, there is not a chemist, not an engineer, worthy of the name, who would not prefer efficient, honorable public service, freed from party politics, to a mere money-making job.

But most governments of the world have been run for so long almost exclusively by lawyer-politicians, that we have come to consider this as an unavoidable evil, until sometimes a large experiment of government by engineers, like the Panama Canal, opens our eyes to the fact that, after all, successful government is—first and last—a matter of efficiency, according to the principles of applied science.

Was it not one of our very earliest American chemists, Benjamin Thompson, of Massachusetts, later knighted in Europe as Count Rumford, who put in shape the rather entangled administration of Bavaria by introducing scientific methods of government?

Pasteur was right when one day exasperated by the politicians who were running his beloved France to ruin, he exclaimed:

> In our century, science is the soul of the prosperity of nations and the living source of all progress. Undoubtedly, the tiring daily discussions of politics seem to be our guide. Empty appearances! What really leads us forward are a few scientific discoveries and their applications.

PRELIMINARY REPORT ON THE DISCOVERY OF HUMAN REMAINS IN AN ASPHALT DEPOSIT AT RANCHO LA BREA[1]

Introduction

In January, 1914, the Museum of History, Science and Art of Los Angeles, being inconvenienced by heavy rains filling the pits already in process of excavation in the asphalt deposits at Rancho La Brea, began work at a new locality, which was designated as pit number ten. Work was started at a point a short distance southwest of a large pit from which many remains of extinct animals had been obtained in previous years. The point at which excavation was initiated was marked by a seepage from which tar had poured out in comparatively recent time. The excavation of this locality showed the presence of two vents

[1] Read at the Museum of History, Science and Art, Los Angeles, California, June 11, 1914.

or chimneys filled with asphalt. The chimneys were each about three feet in diameter and both had contributed to a hard asphaltic layer forming the surface of the ground at this point. At a depth of about eight feet the chimneys opened into a large dome-shaped asphaltic mass not less than eight feet in diameter and extending downward to an unknown depth.

Remains of many kinds of animals were obtained in both chimneys, but the most interesting discovery was the finding on February 5 of an upper jaw from a human skull, at a depth of a little more than six feet, in the northerly of the two chimneys. Careful investigation of this vent disclosed later almost the entire skull with other portions of the skeleton. The remains evidently belonged to one individual. The bones were found ranging in depth down to a level of about nine feet below the surface, and reaching almost to the point at which the chimney connected with the dome-like reservoir below.

Realizing that this find might prove of exceptional scientific interest, unusual precautions were taken in the excavations following the discovery of the human remains. Under the direction of Mr. Frank S. Daggett, director of the Museum, and of Mr. L. E. Wyman, who had immediate charge of the work in the pits, the excavators obtained all possible information as to the nature of the deposit in which the specimen was found, and every bone appearing in the deposit was saved. The final results of the work give us a complete map of the deposit, and full list of the animal remains from the two chimneys, with their situation in the chimneys.

Through the courtesy of Mr. Frank S. Daggett, director of the Museum of History, Science and Art, it has been the writer's privilege to follow closely the course of the excavations in the pit in which the human remains were found, and to make a study of this most interesting occurrence. Most efficient assistance has been given in every possible way by Mr. Daggett, by Mr. Wyman, and by every one connected with the work. The handling of the excavation by the museum staff, and the careful exercise of precautions necessary to insure the scientific accuracy of the work, are worthy of most favorable comment.

Character of the Problem

As a part of the general problem of the history of the human family, involving questions of the origin and of the true nature of man, the history of the human race in America has interested every thoughtful person. The occurrence of human remains at Rancho La Brea, appearing as it has in close relation to a marvelous representation of life from a past period, has justly demanded attention.

The interest in the human skeleton from Rancho La Brea centers either on peculiarities in the character of the skeleton itself, or in evidences of its antiquity furnished by definite indications of the geologic age of the deposits in which it was found or through proof of age presented by the animals associated with the skeleton.

Nature and Origin of the Deposits Containing Human Remains

Purely geologic evidences of age are often exceedingly difficult to obtain in asphalt deposits, owing to the peculiar mode of accumulation, and the possibility of movement in the deposits after they are once formed. The asphalt is a residue from evaporation of oil. It accumulates either on the surface of the ground or in the midst of other strata into which it has soaked or poured. Even after the asphalt deposit has formed, the nature of the viscous material makes possible considerable movement in many directions within the mass, and consequent change of position of any materials in it.

The deposits in which fossil remains have been found at Rancho La Brea are evidently in part layers formed on the surface, and in part pipes, pockets and chimneys through which oil came up from deeply buried strata. The source of the asphalt or oil is a deep-lying formation, which is considerably folded, and is covered by approximately horizontal layers of clayey and sandy strata washed in from higher land not far away. Oil and gas have

been seeping through the superficial horizontal deposit for a very long period, and have formed more or less definite channels or pipes along lines of least resistance. In some cases these pipes have evidently enlarged themselves locally to chimneys several feet in diameter.

At pit number ten, in which the human remains were discovered, the asphalt deposit consists of two pipes or chimneys connecting with surface flows above. The chimneys arise below from a large dome-shaped asphaltic reservoir. This dome may be an old surface pool now buried and forming a part of the passageway for further upward movement of oil; or it may be an enlargement of a chimney that was originally very much smaller.

The asphalt in the chimneys and in the dome in pit ten was largely a soft, viscous mass containing a high percentage of sand, and including in some regions many angular lumps of hard, weathered asphalt. The contents of the chimneys are entirely unlike the surrounding soil or rock. The material through which the chimneys pass is not homogeneous, but is composed of approximately horizontal strata of clay, sand and gravel, with a small inclusion of asphaltic material in most places. The contact between the chimneys and the matrix through which they pass was everywhere sharply marked.

The sand content of the asphalt in the chimneys and in the reservoir below is quite uniform in grain and in distribution through the mass. The sand may have been mingled with the tar by entrance through the upper end of the chimneys or may have been carried up from below. The available evidence favors the view that it came from the sandy layers from which the oil is seeping upward, or through which the oil passes on the way.

The lumps of hard asphalt embedded in the soft sandy matrix in one chimney are generally of irregular form, and may be much oxidized or weathered. They were evidently derived from asphalt masses that were oxidized by exposure to the weather for a considerable time. They are not found in the dome below and evidently came into the chimney from above.

The chimneys in pit ten may have originated through gradual building up of the walls around open pipes connected with the oil-supply below. They may have developed as channels forced through deposits already formed. Regardless of the mode of origin, the chimneys have certainly been passage-ways through which asphaltic materials have moved sometimes up and sometimes down for a period of unknown extent. It is not improbable that at one time these pipes were longer than at present, the surface of the ground being at a relatively higher level. Erosion may have carried away many feet of deposits at this point, shortening the chimneys much below their length at an earlier time. If the history of these chimneys is like that of some now open in this region, they may have spilled their contents widely at times, and on other occasions, the tar may have receded, so as to leave long empty tubes or chambers. If such a period of recession lasted any great length of time, one would expect the tar around the opening above and adhering to the walls of the tube to be much weathered.

In various ways, dry, oxidized pieces might be broken off around the vent and accumulate as angular fragments below. A later rising of the tar would give a mixture of tar, sand and weathered lumps. If the whole chimney stagnated and oxidized for a time, a later outbreak of oil or asphalt following along the side of the old channel would give two parallel pipes filled with somewhat different materials.

As nearly as one can judge from observations available, the north chimney had a varied history presenting stages like most of those discussed as possibilities. The south chimney, containing only soft, sandy asphalt, evidently had a more uniform history or a shorter history.

Remains of Animals Found in the Pit Containing Human Remains

Bones of birds and mammals were abundant in both chimneys. In the south chimney, which is wide above and narrows sharply below, large bones are found only above the nar-

rowing of the pipe. In the large reservoir below the chimneys only small bones appear, and these were found only in a limited space near the point of union of the lower reservoir and the two chimneys. The distribution of bones shows conclusively that they came from above, and were not carried up from the depths with ascending oil.

The total number of specimens found in the chimneys was large, and will aggregate several thousand. These bones represent a considerable variety of mammals and birds. They include bear, coyote, a wolf of the timber-wolf type, skunk, weasel, horse, antelope, rabbit, pocket-gophers, field-mice, eagles, owls, vultures, crows, and many other forms.

The fauna from the two chimneys in pit ten is in general like that of California at the present time. It differs greatly from that of the pits in which the well-known Rancho La Brea fauna is found through the absence of the great wolf, saber-tooth, sloth, small antelope, camel, and many other mammals and birds abundantly represented in the typical Rancho La Brea deposits.

The only extinct form certainly recognized in the material from the two chimneys is *Teratornis,* a gigantic condor-like bird, as yet known only from Rancho La Brea, and recognized by Dr. L. H. Miller in this collection. Bones of this bird were found in a narrow portion of the north chimney at a depth of about four feet, and considerably above some of the human remains. As nearly as one can judge from the evidence at hand, there seems a reasonable chance that the giant *Teratornis* was a contemporary of the human being whose remains appear in the north chimney of pit ten. The evidence does not present clear proof in favor of this view, but appears to balance in that direction.

The extinct California peacock and two other extinct species are doubtfully reported from the north chimney, but there is doubt as to their having been introduced in the same manner as the other bones making up the fauna.

A small collection found near the upper end of the north chimney contains a number of birds, which, according to Dr. Miller, are quite different from those certainly known from the two chimneys. The matrix in which this small collection was found is also different from that in the chimneys. It seems probable that these specimens really represent an older fauna embedded in a relatively ancient deposit through or near which the north chimney passed.

A portion of the lower jaw of a young horse found at a depth of about five feet and near the *Teratornis* in the north chimney is more slender than any lower jaw of the common extinct horse found in the typical Rancho La Brea fauna. The writer has not, however, compared it with fossil specimens of exactly the same individual stage of development. In slenderness it approaches more closely the jaw of the existing domestic horse. The space between the back teeth and front teeth seems shorter than that in the domestic horse, and is of nearly the same length as in the extinct species from Rancho La Brea. A more careful study of immature specimens from Rancho La Brea in comparison with very young modern horses will be necessary before one can speak authoritatively with reference to the specific determination of this specimen. It will be very interesting to know whether this is an extinct species which lived in California until a comparatively recent time and was contemporaneous with man, but became extinct before this country was visited by white men. The alternative hypothesis is that it represents the colt of a modern horse which fell into the pit within the last century and a half.

The fact that the fauna from the two chimneys is nearly or quite identical with that of the present day, while the typical Rancho La Brea fauna differs greatly and shows close resemblance to the life of the earth at a remote time, makes it evident that the fauna represented in the chimneys of pit ten pertains to a period much later than that in which the typical Rancho La Brea animals lived. The collection from the chimneys represents a time so close to the present that the types of life were nearly the same as those in the region at

the present day. The giant *Teratornis,* and possibly several other extinct forms in this fauna, may indicate that the asphalt in these chimneys was trapping animals at a time removed by some thousands of years from the present. On the other hand, it may be that these species were living here within historic time. A third possibility is that the bones of such extinct species as are found here have been removed in some way from an older deposit, and found a resting place in the chimneys in comparatively recent time. Still more remote is a fourth possibility that in Pleistocene time these chimneys connected with an open pool far above the present surface of the ground; that bones of a few animals trapped at that time sank to the position in which they were found in the excavations; and that after the removal of the upper deposits by erosion, the later or younger fauna was trapped and mingled with the few bones of earlier date.

The Human Remains

The human bones were all found in the north chimney, where the history of accumulation is more complicated than in the south vent. The pit containing the human remains also contains all of the presumably associated specimens representing extinct animals.

The human remains were found rather widely scattered between a depth of about six feet and nine feet. The whole collection of human bones seems to represent one individual. The bones are generally very much worn. The wear in some cases suggests movement within the pit in such a manner that sand in the tar, or resting against the wall of the chimney, has cut away the bone by long-continued rubbing.

Enough of the human skeleton was found in the pit to give a fairly satisfactory idea as to the characteristics of the individual it represents. The skull is that of a small person of middle age, possibly a woman. The brain case is relatively as large as that in some of the living native races of America. According to Dr. A. L. Kroeber the racial characteristics do not differ decidedly from those of people whose remains have been excavated in mounds on Santa Rosa Island off the coast of southern California. So far as the characteristics of the skeleton are concerned, it is not necessary to suppose that we have here an individual who lived at a remote time when the human family was in a relatively low stage of evolution. This skull is not comparable to those of ancient races of the Neanderthal or earlier types. On the other hand, one must not forget that people of a fairly advanced stage of brain development were already in existence at the beginning of the present or Recent geological period.

The characters of the human remains taken by themselves indicate that this person lived either within the present or Recent period, or at a time not earlier than the end of the Pleistocene period immediately preceding it.

Conclusions

A summary of available information regarding the age of the human skeleton found in pit ten at Rancho La Brea is as follows:

1. The evidence of geologic occurrence in the asphalt chimney taken by itself counts for relatively little owing to the peculiar conditions under which these deposits are formed. In so far as this is of value it suggests an age later than that of the tar pits containing the typical Rancho La Brea fauna.

2. The fauna associated with the human remains in pit ten is quite different from the typical Pleistocene Rancho La Brea fauna, and must have inhabited this region at a different period. The fauna in pit ten is closely related to that of the present or Recent period. It is distinctly later in age than the typical Rancho La Brea fauna.

3. The characters of the human remains, taken by themselves, show a stage of development similar to that of man of the present day and not earlier than man of the latest Pleistocene time.

4. The evidence as a whole indicates that the human skeleton from pit ten is of a period much later than that of the typical Rancho La Brea fauna, the time being either within the Recent period or not earlier than the very latest portion of Pleistocene time. The possible association of the human remains with

extinct forms, such as the giant *Teratornis*, may indicate some antiquity for the human being, or may indicate comparatively late persistence of birds or mammals now extinct in this region.

5. Measured in terms of years, it is not possible to give a definite estimate of the age of the skeleton from pit ten. It may suffice to state that this person did not live in the period of the low-browed, Neanderthal, Pleistocene man of Europe. It belongs to the distinctly modern stage of evolution. It does not necessarily belong to the present historic period, but can not be considered as having antedated it by many thousands of years. The age of this specimen may perhaps be measured in thousands of years, but probably not in tens of thousands.

6. The study of the remains at pit ten is a problem similar to that presented by the occurrence of an arrowhead found in a comparatively recent asphalt deposit encountered in the University of California excavations of 1912. The arrowhead was found embedded in a deposit somewhat similar to that in pit ten, and the fauna associated with it was in general of Recent aspect.

7. The final summing up of all evidence relative to the antiquity of the Rancho La Brea skeleton will depend on a very detailed and exhaustive study of the typical Pleistocene Rancho La Brea fauna, of the fauna from the later tar deposits like that of pit ten, and of the existing fauna of California. No one of these three factors is, as yet, satisfactorily known. Until they are all known, the last word on this subject can not be written. The significance of this statement may seem larger when reinforced by the remark that the skeletons of a large percentage of our living species have never yet been carefully studied in the way in which this work must be done for use in investigations such as those concerned in this problem.

From whatever point of view this specimen is considered, it is well worth exhaustive scientific investigation.

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UNIVERSITY OF CALIFORNIA,

June 11, 1914

THE 72-INCH REFLECTING TELESCOPE FOR CANADA

SOME eight months ago the Canadian government entered into contracts for the construction of a 72-inch reflecting telescope, with the J. A. Brashear Company for the optical parts and the Warner and Swasey Company for the mounting. This telescope, which will be considerably larger than any in use, will be of the most modern type and will be used principally in the determination of stellar radial velocities. The progressive policy of the Canadian government in the encouragement of scientific research, as evidenced by the order for this magnificent instrument has now been rendered doubly effective by authorizing at a very considerable additional expense, the total outlay being upward of $200,000, its installation in the best astronomical location in the dominion.

Investigations have been in progress for upwards of a year at five places, representative of different climatic conditions in the country. The region around Victoria, B. C., so much excelled all the others, including Ottawa, in the two most important particulars, the "seeing" or steadiness and quality of definition, and the small daily temperature variation, while being at least equal in other qualifications, that it was strongly recommended to the government by the chief astronomer as the site for the telescope. The government of the province of British Columbia, on being approached for help towards the additional cost of location away from Ottawa, generously contributed $10,000 for the purchase of the necessary land and agreed to build a road, which will cost about $20,000, to the chosen site which is at the summit of Saanich Hill, altitude 732 feet, about eight miles north of Victoria.

Immediately on the decision of the dominion government in favor of this site, fifty acres of land were purchased around the summit of the hill, and arrangements were concluded for the construction of the road this fall. This road will be upwards of a mile and a half in length, leading from the main road and the electric railway at the foot of the hill by a 7 per cent. grade to the summit.