Photo from American Museum of Natural History, N. Y.

Haida Canoe and native Chiefs in regalia for the "Potlatch," "Museum of Natural History

Popularizing Anthropology

What Museums Are Doing to Make Science Attractive

By Edward Hale Brush

THE idea that anthropology and ethnology are studies for only a learned few was formerly held by the general public. But in recent years the museums have been making such study so attractive that he who runs is inclined to stop and read. And he may, even in the hurry of the ordinary American life, learn something in passing of the outline of the history and development of the race and perhaps this may tempt him to a closer scrutiny of the subject.

This is part of the general policy of making the museums places of resort and education for the masses rather than institutions whose privileges are mostly reserved for connoisseurs or scientific experts. In the case of ethnology and archaeology the fields of exploration and research have yielded such rich fruits in recent years that there is special reason for placing these results before the public so that they may be readily understood and appreciated. There is also the growing sentiment that relics of the aboriginal races of our own continent should be preserved with especial care and that the customs and folklore of such races, as well as the remnants of their dwelling places, should be kept from disappearing into oblivion.

There are two main aspects of the study of anthropology, one pertaining to living types of primitive man and the other to races of the past, no matter how far back into the dim and distant ages this research may go. Be it man dead and gone a hundred thousand years or man of the primitive type living today in remote corners of the earth, for one or the other the hunt has been proceeding with particular zest in the past few years and quite recently some exceedingly valuable finds have been made which add to our knowledge of what we call the human race. For it has been the human race since the epoch of the earliest well-authenticated relics. Such relics contain proof of remarkable resemblance between the men of 150,000 or even 200,000 years ago and those of today.

Not so very long ago all one could find in a museum to illustrate the subject of anthropology was cases of specimens collected from burial mounds or obtained from travels among wild tribes of men. However interesting to the student these might be they did not attract and fascinate the average person and in them

alone there was little to lead a visitor on to further study and investigation of the really absorbing theme of the development and progress of the race.

The contrast to the former conditions is illustrated in some reproductions of aboriginal and primitive life recently installed in the Hall of Anthropology of the American Museum of Natural History, New York. Art has been effectively and ingeniously employed in the restorations of this and other museums and quite a new and boundless field has been developed in this way for mural painters, sculptors and devotees of various

lines of art craftsmanship. First efforts along these lines may have been crude but better standards are being attained. This is exemplified in the groups mentioned which really deserve praise as works of art and are very life-like portrayals of the aboriginal peoples of the American southwest. They show them engaged in their customary vocations. A motion picture could scarcely be more graphic. Through the employment of both sculpture and painting an impression of reality is gained which is almost startling. One seems to see these Indians, who are of the Apache and Hopi groups, actually before one in life, weaving rugs, tarring baskets, building teepees, or engaged in other domestic tasks, there being no suggestion of warfare, since that has too often been overemphasized in portrayals of the American Indian. The sculptor of these groups is Mahonri M. Young and he worked in collaboration with a mural painter who has given especial study to aboriginal life, Howard McCormick. The skill shown in these groups results in distance being simulated in a surprising manner and the lighting is such as to give a warm sunny effect which seems like nature itself.

In the Apache group a woman is in the foreground, tarring a basket under a summer habitation built of boughs. A naked youth in the middle distance is modeled with skill and there are other figures of children, women and warriors, with a background of mountains painted by Mr. McCormick. The Apache were chosen for this group as representing the nomad Indians of the Southwest. They make use of small, easily constructed houses which are deserted when the occasion arises. During the summer months they spend much time under flat-topped sunshades supported on forked posts which afford protection from the sun but permit free entrance of the cool breezes. They also construct dome-shaped houses and a woman is seen engaged upon making one in this group. The Hopi Indians are the subject of the other group by Mr. McCormick and Mr. Young and there is to be a third presenting a ceremony of the Navajo.

Artists and artisans of various orders of genius have been called on in the illustration and arrangement of the rare treasures which have been brought

Maori warrior defying war gods in dance. Figure on a piece of jade in American Museum of Natural History, in hall showing cultures of South Pacific. By courtesy of the museum

Photo from American Museum of Natural History, N. Y.

Neanderthal man of La Chapelle aux-Saints estimated to have lived as long ago as 40,000 years. Restoration by J. H. McGregor, Department of Zoology, Columbia University

back by ethnologists and archaeologists in the expeditions sent out by the great American museums and universities and some European institutions to explore among primitive tribes and observe their ethnic peculiarities or excavate in lands where relics of ancient peoples are to be found. All such research throws light upon the evolution and history of the race from the primeval period down. Such discoveries as those of Prof. Vilhjalmr Stefansson in the Far North and such expeditions as those of Yale University and Amherst College in Latin America, of Rodman Wana-maker in the American Southwest and those to Aus-

Pithecanthropus Erectus. Upright standing Ape man of Java. Restoration by J. H. McGregor. Head modelled on a restoration of the skull, of which only the skull cap and two teeth were found. Estimated antiquity 500,000 years

popularizing the study of ethnology. The discoveries that have been made in various lines of ethnological research will ultimately serve as a basis for constructing a history of the race for many ages prior to what we have been accustomed to consider the dawn of history and this great and wonderful story must be told so that the people can appreciate it, as they are now trying to do in the museums. Interest in the American aborigines is helping this movement and being helped by it. An instance is the institution of American Indian Day, May 13th, observed in 1916 for the first time by governmental proclamation. It reminds us of the Redmen and the many aspects of their character which are worthy of being remembered even though some barbaric occurrences connected with their relations with the whites are not pleasant to recall. Governor Charles S. Whitman of New York in his Indian Day proclamation invited "the attention of the citizens of the State of New York to the history, the social institutions of these people and especially to the present and future needs of the 5,000 Reservation Indians now resident in this State."

The State Museum at Albany has a splendid collection of the relics of the Six Nation Indians of New York, the League of the Iroquois. A recent issue of the Bulletin to the schools, published by the University of the State of New York, was devoted to this subject and it said:

"This Bulletin is devoted to the Indians of our State because we want the teachers and children to know the Indian as he was; to understand the ex-

Photo from American Museum of Natural History, N. Y.

Type man of Cro-Magnon race. Estimated antiquity, 25,000 years. Restoration by J. H. McGregor

traordinary character of his native government, and to appreciate his decisive influence in the early history of New York. We wish all to know what is being done in the State Museum to perpetuate the memory of our remarkable aborigines. The soil of our State is scattered with relics of Indian occupation—arrowheads and spearheads, axes and other articles of stone, beads, pottery, etc. They are the remains of a vanished culture, and the State Museum desires to acquire and preserve everything of this kind to the end that there may be preserved a faithful picture of the unique political and social life of the 'Men of Always.'"

Photo by American Museum of Natural History, N. Y.

Rockpainting of reindeer in cavern at Dordogne, France. Reproduction in the American Museum of Natural History

The League of the Iroquois has now transferred its archives of wampum to the keeping of the State Museum. In the Museum halls are being erected a series of restorations designed to portray to the generations of today the Iroquois and their activities as

Photo by American Museum of Natural History, N. Y.

Art of the Cro-Magnon race. Reproduction of polychrome rockpainting of bison, in cave at Dordogne, France

tralasia and the North Pacific under the auspices of the American Museum of Natural History, or of the Brooklyn Institute of Arts and Sciences to Alaska and New Mexico have done much not only to direct public attention to such subjects but to afford material for

Hopi Indians as pictured by Mahonri Young and Howard McCormick, American Museum of Natural History

Photo by American Museum of Natural History, N. Y.

Apache group, American Museum of Natural History, by Mahonri Young and Howard McCormick

they were before the coming of the white men. One of these mural decorations presents a hunting scene among the Senecas. The background of the scene is a painting 55 feet long, picturing the shores of Canandaigua Lake, N. Y., and Genundewa, the sacred hill of the Senecas, and in the foreground is a family group busied with hunting, dressing of food, skiving of skins, etc. There will be six of these groups in the Iroquois Hall, all with backgrounds of historic scenes with foregrounds filled with life casts taken from the Iroquois of New York. It is perhaps the most elaborate restoration of this kind yet undertaken.

The Delaware Indians, who were of a stock closely related to the Iroquois, have been made the subject of some interesting restorations by Dwight Franklin in the Newark, N. J., Museum, which is in the territory over which the Delawares roamed. These show the bark lodges or "long houses," in which the Delawares lived, of the same type of dwelling as the Iroquois bark lodge, and scenes typical of the customs of the Delawares. By the use of both paintings and of figures and groups, modelled in wax or plaster and suitably costumed, very realistic representations are given which may be at the same time highly artistic. This is the case in the series of panels for the halls of ethnology of the American Museum of Natural History in New York by Edwin Willard Deming. Mr. Deming stands at the front as a painter of Indian subjects, having given his entire career since early manhood to efforts to interpret through artistic mediums the folklore and tribal customs of the Redmen. His mural decorations for the Natural History Museum are no doubt the most important works of the kind ever executed and increase very much the educational value of the ethnological collections in the halls which they adorn.

The Brooklyn Institute of Arts and Sciences has installed collections in its department of ethnology which give a vivid idea of the life of the Alaskan Indians and of the Zuni and other pueblo or cliff-dwelling red people of the American Southwest. Through them even the casual visitor may learn much of the industries of these people, the kind of habitations common among them, their religious customs, etc. There are models of the pueblos of New Mexico, collections illustrating the aboriginal life of Central and Northern California, past and present, and oil paintings of scenes along the southwestern border of the United States. There are decorative pictures representing the Haida Indian village of Massett with the adjacent landscape on Queen Charlotte Islands, British Columbia. The Alaskan Indians present a very picturesque and fascinating subject. Paintings by H. B. Judy of the Museum staff help to carry out the details of the picture presented and one sees the relics in their proper relation to this curious aboriginal life. Some of the totem poles are very fine specimens, several being house posts, used as supports within the dwelling, by Indians of Van Couver Island.

The Smithsonian Institution at Washington, D. C., has done a great deal through both its collections and the researches under its auspices to promote popular interest in this subject. Some of the results of the exploration and field work of the Institution among various races of mankind were recently shown in connection with the anthropological exhibits of the Panama-California Exposition at San Diego. Three years were required in the preparation of this exhibit under Dr. Ales Hrdlicka and five rooms in the Building of the Science of Man were filled. One room illustrated Human Evolution and contained a series of accurate, first-class casts of all the more important skeletal remains of authentic antiquity.

In passing it may be remarked that the Bureau of American Ethnology of the Smithsonian Institution has done much to preserve the music of the American aborigines, using for this purpose both musical scores and phonographic records. The phonograph has also been used in preserving linguistic records and has proved a valuable ally of the scientist. Even the motion-picture machine has been utilized in such work especially in recording upon the film the appearance of ceremonial rites.

There is a wealth of material illustrating anthropology in a popular way at the American Museum of Natural History. A single instance will show the growth of the idea. Twenty-five years ago, when the Museum was much smaller, visitors might have noticed suspended from the ceiling in the Heber R. Bishop collection a 60-foot Haida canoe. Not long since, with the view of popularizing the collection, this canoe was brought down from the ceiling, placed on the floor of a new exhibition room where Eskimo,

Alaskan and Siberian cultures are shown, and gradually filled with figures in plaster of Indians of this region performing tribal rites. The figures are the work of Sigurd Neandross, Norwegian sculptor of ethnologic subjects, and with the masks, weapons and other accessories form a comprehensive symbolic group. In the foremost position is a Chilkat chief in full ceremonial dress, his followers being arrayed in regalia for the "potlatch," in which families gladly impoverish themselves in order that the dead may be honored, the emblem of the clan exalted, or the social standing of the tribe recognized.

Again, take the work of the same museum in making attractive and graphic the collection illustrating customs of the South Pacific. A foremost position in this collection is given a figure of a Maori warrior standing on a large piece of jade—said to be the largest ever obtained in a single piece—and defying the war gods in a grotesque and curious dance. In the same collection are fine specimens of the tattooed human heads—relics of ancestors, or of enemies conquered in battle—which the warrior lords of Maori families took delight in bringing out for feasts or other great occasions.

In furtherance of this same idea of adding attractiveness to the story of race development the authorities of the museum have recently installed a series of mural panels by Will S. Taylor in the hall devoted to cultures of the North Pacific. They hang like tapestries between the weathered totem poles and help to provide an atmosphere investing with life and reality the inanimate objects displayed. With glaciers or cool mountain shades as backgrounds we see the weavers, the carvers and the basket makers and canoe builders whose works are gathered in the hall. A decoration picturing the steaming and adornment of the Haida canoe is placed above the collection illustrating the customs of the Haida people, who occupy the country south of the Tinian, including the Queen Charlotte Islands, and another panel portrays the Chilkat blanket makers at work, this product being not only the emblem of the clan but an expression, in a sense, of its folklore. The series forms a splendid portrayal of the customs and handicraft of these simple people and gives an insight into their industrious characteristics. At the Metropolitan Museum similar ideas are being followed in the effort to educate the public respecting the life of antiquity. This was strikingly shown at the opening of the new department of Egyptian antiquities in which are displayed the fruits of the labor of the expedition which the museum had in the Land of the Pharaohs for several years under the direction of Albert M. Lythgoe, curator of Egyptian art. Some of these priceless relics carry one back to a period 4,000 years before the Christian era, to a time close to the Neo-Lithic age. It is not so long since people generally believed the earth to have been created about the time when, as these remains show, a comparatively complex culture had been developed in the Nile country, all of which is very significant as to the age of the race.

At the American Museum of Natural History there is a fine collection of human bones and implements from the banks of the Delaware River, near Trenton, N. J., bearing upon the question of the antiquity of man on the American continent. This collection was made by Ernest Volk under the direction of Prof. F. W. Putnam and in describing it the museum authorities say:

"The antiquity of man on the American continent is a mooted question. In the Old World there is an abundance of indisputable archaeological evidence found in caves and glacial deposits dating back through the geological time known as the Quaternary epoch, which began many thousands of years ago. Many alleged finds of implements and human bones have also been made in both North and South America in deposits regarded as of Quaternary and pre-Quaternary ages; but thus far the majority of these finds have been explained by good authorities as incidents, accidents, frauds or at best as the results of imperfect knowledge of the circumstances on which the antiquity of the specimens depended. There is, however, no inherent reason why evidence of a Quaternary man may not be found in the Western World. The exhibit in the case is perhaps the most convincing proof thus far advanced for the antiquity of man in America. . . . There is no absolute proof that the gravel in which the bones were found was not redeposited by water since the glacial epoch. Hence the whole question of man's antiquity in America awaits further investigation. Few archaeologists are convinced by the facts presented but for the present it may be at least re-

garded as entirely probable that man did live in the Ohio and Delaware valleys amid different faunae from those now existing and at the close of the Ice Age, which ended the Quaternary epoch about 10,000 to 15,000 years ago."

The work of the Yale ethnological expedition in Peru affords reason for belief that rich finds bearing on the subject will be made, for not only have these investigators uncovered many relics throwing light on the period of the Incas but they have secured traces, as they believe, of men who lived in South America as long ago as the glacial epoch. The whole question is inseparably connected with that of the age of the race as a whole. It is only in recent years that the general public, whatever the views of scientists, has come to realize the great age of the race and what a slow process it has been to develop it to the present stage. With the Garden of Eden eliminated as a starting point, by well-informed theologians as well as ethnologists, and some weird, primeval yet human creature who lived some half million years ago substituted as the first man of whom we can find undoubted relics, the problem of building up the historic story is much altered from what it was when 6,000 years was commonly accepted as the age of the race. It is here that the students of ethnology who go among the primitive tribes of today and bring back the fruits of their study to the museums and galleries aid in filling in the details which picture to us how the men of the far-distant ages, even hundreds of thousands of years ago, must have lived. The aid of the geologists and paleontologists is an essential factor, also, in such research. Thus we learn from geology of the connection of the British Isles with the European continent in glacial times, permitting free migration of animal life and human culture from the land to the south so that the Lower Palaeolithic peoples wandered at will from the Valley of the Somme to the Valley of the Thames, interchanging their weapons and inventions.

Some extremely important finds bearing on the story of prehistoric man have taken place within the past ten or fifteen years—some of the most important within the past five years—and the museums are just beginning to be able to present the results of these discoveries by means of paintings, models, casts, restorations and other mediums easy of comprehension by the average visitor. Among these discoveries are the relics of the art of man of 25,000 years ago found in the caves of the Pyrenees. The American Museum of Natural History is now engaged in installing exhibits illustrating these discoveries, which reveal the artistic achievements of men who lived and worked and aspired in Europe in the glacial epoch. Even men of science had scarcely supposed until these discoveries were made that the men of 25,000 years ago possessed much taste for art or skill in its achievement, certainly not such attainments as these astonishing finds reveal. Prof. Henry Fairfield Osborn of the Natural History Museum and of Columbia University has described them most graphically in his now famous work, "Men of the Old Stone Age," as well as in various publications of the Museum. In the preface to his most recent work he tells us: "This Palaeolithic tour of three weeks (among the caves of the Pyrenees) made a very profound impression, namely, of the very early evolution of the spirit of man and of the close relation between early human environment and industry and the development of mind, of the remote antiquity of the human powers of observation, of discovery, and of invention. It appears that men with faculties and powers like our own, but in the infancy of education, and tradition were living in this region of Europe at least 25,000 years ago. Back of these intelligent races were others, also of eastern origin but in earlier stages of mental development, all pointing to the very remote ancestry of man from earlier mental and physical stages. Another great impression from the region is that it is the oldest center of human habitation of which we have a complete, unbroken record of continuous residence from a period as remote as 100,000 years, corresponding with the dawn of human culture, to the hamlets of the modern peasant of France, A. D. 1915. In contrast Egyptian, Aegean and Mesopotamian civilizations appear as of yesterday."

According to Prof. Osborn the history of these men of superior intelligence who were "gifted with a strong artistic sense" extends "from the close of the glacial age, 25,000 to 20,000 years ago, to the arrival of Neolithic men, perhaps 10,000 years ago. There was a crude form of religion, the dead were reverently buried, society was broken up into groups according

to special talents, there were undoubtedly chiefs or rulers, hunters, flint makers and especially sculptors and painters, whose art exceeds that of any other primitive men, ancient or modern." Prof. Clark Wissler says, speaking of the significance of these cultures: "The universal human was there in that dim, remote past, as it is with us still."

These ancient Europeans belonged to what has been called the Cro-Magnon race by the archaeologists. Back of them in Europe were the Neanderthals, so-called from the valley in Germany where the first find of skeletal remains of this race was made fifty years ago, about the time that Darwin's theories of origin of species were first attracting attention. Many relics of this race have since been found in Western Europe. They were much more primitive than the Cro-Magnons but within a very few years relics of men of even more archaic type than the Neanderthals have been uncovered. In 1907 a human jaw was found in the Mauer sands near Heidelberg by Schoetensack. The discoverer referred the Heidelberg man to the First Interglacial stage. Osborn places it in the second, estimated at 250,000 years ago. The circumstances of the find indicate how such things sometimes occur. It was made at a depth of 79 feet from the upper surface of a high bluff in ancient river sands which had long been known to yield very old mammalian fauna and for years the workmen had been instructed to keep a sharp lookout for human remains. Thus was made a discovery of momentous importance.

In 1912 and 1913—some parts being picked up at one time and some at another—Charles Dawson, the eminent geologist and associates, found the Piltdown skull, at Piltdown, Sussex, Eng., "one of the most important and significant discoveries in the whole history of anthropology." The Piltdown man is known as Eoanthropus, the "dawn man," and Prof. Osborn says is "the most ancient human type in which the form of the head and size of the brain are known." Study of the characteristics of Piltdown man is aided at the American Museum of Natural History not only by restorations of the skull and facial conformation but by cases containing flint implements illustrating the culture type of the period. In the strata where the Piltdown skull was found were also discovered primitive tools. They indicate that it was the dawn stage of human invention.

The Trinil race of Java has been so named from the discovery near Trinil in Central Java in 1891 by a Dutch army surgeon, Eugen Dubois, of a skull and thigh bone and two molars believed to belong to an apeman, *Pithecanthropus Erectus*, that is, upright-

standing apeman. Anatomists have concluded from the form of this thighbone that "this fossil creature had the same upright posture as man and likewise walked on two legs," and "from a study of the femur and skull it follows with certainty that this fossil cannot be classified as simian." The length of time ago that this creature is supposed to have lived is placed at about half a million years. The most authoritative geological research refers the remains to early Pleistocene times rather than Pliocene as Dubois, the Dutch discoverer, supposed. This is important because it might admit of a variation of several hundred thousand years in the age of the relics. It may increase the popular interest to add that this specimen of the Trinil race, being of erect posture, possessed no tail.

We may gain many hints about the characteristics of these early men, especially the Neanderthals and Cro-Magnons, from the implements they left as well as from the conformation of their skeletal remains. Study of the tools of the Old Stone Age—which should be distinguished from the New Stone Age—is a science in itself and its results throw much light on the environment and life of the men of the most ancient races. Similar study gives us some idea of the time when fire was discovered, or put to domestic use, and the family or tribal hearthstone set up. These tools indicate to us also something about the garb in which these primeval men and women arrayed themselves. From such study, for instance, we learn that the Neanderthal man of Chapelle-aux-Saints, discovered in 1908, and inhabiting Central France in times of what is known as the Mousterian culture, had reached a considerable degree of intelligence. His antiquity is estimated at from 25,000 to 40,000 years. The fact that some, at least, of these Neanderthal men practiced ceremonial burial indicates the dawn of a belief in some kind of a future existence.

Painters have sought to depict the scenes of the Stone Age and even the novelists have recently been taking characters from it. While it is not possible as yet to reconstruct in much detail the life of the times in which the earliest races like those of Heidelberg and Piltdown lived, no doubt the museums by employing the same methods used in depicting the customs of the primitive men of today will soon be giving us pictures in outline of the ways of more ancient man. Already something in that direction has been attempted. One such effort is that of Mr. Franklin, sculptor of the Delaware Indian restorations already mentioned, who has recently completed a restoration of cave people of Neanderthal type. A man and woman stand at the mouth of their cave. They have been disturbed at

their meal within by the approach of a bear. The man grasps a stout weapon. The cave woman, a baby in one arm, is reaching out quickly in the other for a spear. The cave bear Mr. Franklin believes to have been like the Alaskan grizzly, and he has so modeled the beast. Besides the fashioning of stone weapons the man knew how to make a fire. Its light is seen from within the cave.

In restorations of this type the imagination, of course, must be allowed some play. But in restorations showing the appearance of primeval man, in features and form, the actual remains are faithfully followed. Restorations of the men of Cro-Magnon, Neanderthal, Heidelberg, Piltdown and Trinil have been very carefully made for the American Museum of Natural History by Prof. J. H. McGregor, and these enable us to compare the relative progress made by the different human types. Among the first to make a really scientific effort at plastic reproduction of primeval man was Richard Swan Lull, Ph. D., professor of vertebrate paleontology at Yale and associate curator of the Peabody Museum of that University. He studied the finds of Spy, Galley-hill, and Chapelle-aux-Saints and sought to put in plastic form his idea of what the man of perhaps 150,000 years ago was like. In the *American Journal of Science* he says of this reproduction:

"The model is based mainly upon what is known as the 'Man of Spy No I,' one of two specimens found at Spy in Belgium, of which the Peabody Museum contains plaster casts. My conception of *Homo Primogenius* is that of a man of low stature, standing only three feet five inches in height, but of great physical prowess, as indicated by the robustness of the limb bones and especially of their articular ends. The great paunch of the higher anthropoid apes, which are almost exclusively vegetarians, is lacking, and in its place is shown the clean-cut athletic form of torso such as one sees in the typical North American Indians, for I imagine food conditions were about the same. This type dwelt in Europe before the last glacial period, estimated at from 100,000 to 200,000 years ago, and continued for a long period of time, for his remains are found entombed successively with both cold and warm climate animals. * * * The man of Spy, while showing more pithecoïd characters than his successors, was nevertheless eminently human, representing as he does the type just preceding modern man and one far removed from a true ape-like ancestry. In the popular conception 'pre-historic man should be gorilloïd, or at any rate, distinctly simian. Against this misconception the model stands as silent protest.'

The New Zeppelins*

THE capture of a super-Zeppelin with all its crew and papers has thrown some interesting light on the progress made by German airships since the days not so very long before the war when a German dirigible paid an accidental visit to Lunéville, and was carefully overhauled by the French air experts before it returned home.

The Zeppelins that came to an untimely end the other day in France are believed to have been of the latest type. Six hundred and forty-three feet in length, their total height is 114 feet, and their eighteen balloons enclosed inside the aluminum framework contain 55,000 cubic mètres (about 1,060,000 cubic feet) of hydrogen. In other words, they can raise 55 tons from the ground.

Their aluminium structure weighs between ten and twelve tons, and to this burden must be added five Maybach motors, each of 240 horse-power, the cars and balloons, the crew, petrol, ballast, and the thousand and one appliances necessary for an aerial voyage.

Allowance being made for all these encumbrances, just two and a half tons at the very most remain for explosives, if they are to be dropped on England.

The amount of bombs that can be carried depends, of course, first on the amount of petrol that must be carried to enable the airship to reach its destination and return; and, secondly, on the height at which the voyage is to be made. If it is to fly at a great altitude much ballast must be carried and the weight of bombs proportionately decreased.

The Germans have learned by bitter experience that if they intend to drop bombs on England without excessive risk from guns and aeroplanes they must navigate at a very great height, and their Zeppelins are built with a view to flying at between 16,000 and 20,000 feet.

At such an altitude they reckon that they should be reasonably safe both against shells and heavier-than-air craft. As a matter of fact, there appears to be some slight error in their calculations, since the other day one Zeppelin was brought down from a height of over 16,000 feet.

The enemy has overcome the vital difficulty of steering when the earth is out of sight by wireless telegraphy. The airship sends out a wireless message, which is received by the German land stations, and as soon as they have determined the direction from which the wireless waves come they can easily arrive at the exact position of the airship and tell it where it is.

The other night the German airships had to struggle against exceptional atmospheric conditions. Take the log of the captured airship. It started out with a gentle West wind that impeded its progress but little, and promised to waft it back most conveniently if anything went wrong. But, all unknown to the enemy, a depression was working up in the Mediterranean. On their journey the wind at a high altitude suddenly veered north and blew with great violence. It was a wind of about 80 feet a second, or about 50 miles an hour.

The Zeppelin, with all its motors working at full power, could travel at rather more than 60 miles an hour, so that if the pilot had been aware of the change of wind he could have gone back to Germany without excessive difficulty. The north wind was not directly contrary, so that he would only have had to make allowance for it in steering his course.

But it so happened that the pilot of the airship in question had no idea of what was happening. The earth was covered with a thick mist, and he had no fixed point outside the balloon to show him that he was being carried swiftly southwards. When he had dropped his bombs he had only one idea—to rise as high as he possibly could to get out of the reach of aeroplanes and guns. So he went up to a height of no less than 22,000 feet. At such an altitude the cold was

intense. The temperature fell to over 30 degrees below zero (Fahrenheit). The crew suffered terribly, and, to make things worse, as a result of the excessive cold two motors broke down, including the motor that worked the wireless.

Thenceforward, there was no question of steering a course. The pilot, of course, tried to make for Germany, but, all unawares, he was being drifted southwards by the wind at the rate of 50 miles an hour. At length he let out gas and came down, hoping to find himself above Holland. What he found was a squadron of French aeroplanes waiting for him over Bourbonnelles-Baines. The whole crew was bewildered by the terrible cold to which it had been exposed, and had no fight left in it. The airship's armament was almost negligible, only two machine-guns. The result was that the dirigible and its crew were captured.

It has been said that the Zeppelin carries five motors. Three of these motors are in the forward and two lateral cars, while the stern car has two motors. Each car has only one propeller in the stern. The two motors of the stern car only work simultaneously in case of grave necessity. If they are both geared up to the propeller the balloon is under forced draught, with a speed of about 60 miles an hour. As a rule, only four motors are working, and the fifth is in reserve.

The balloon commander is in the forward car, with the greater part of the crew. It was this car that was carried away by the trees on which the Zeppelin landed at Dammartin. The total crew for short raids is twenty-two, for long raids eighteen.

A supplementary statement says:

On the night of the raid the Zeppelins, steering at a height of 15,000 feet and afraid to descend to a lower altitude, found themselves caught in a violent and bitterly cold northerly gale. The wireless directives went astray or arrived in undecipherable shape, and the airships, soon after reaching the English coast, lost their bearings.

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Stone Age scene. Restoration by Dwight Franklin of Home Life of Cave Men and Women. Period of the Neanderthals and the Glacial Epoch
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