commenced there was a depth of 17 feet of solid clay out of a total cover of 34 feet. A solid 8-foot-thick diaphragm wall of brick and cement mortar was built across the tunnel with the working air lock and emergency lock through it together with all the requisite pipes. As the clay bed gradually decreased in thickness greater care had to be observed. When the clay cover to the shield had decreased to only 5 feet the box heading in front of the boring shield was abandoned and compressed air was brought into operation at a depth of 18 feet below the river bed. The shield was forced forward carefully until within about 3 inches of the gravel and sand soil or ballast, and then pockets of pugged clay were made and placed close to each other in advance of the cutting edge of the shield. This provided a soft bed for the cutting edge and shield to slide forward in. The quantity of pugged clay was increased in the ballast face all round the cutting edge; and as the shield then forced its way forward, the clay formed a thin blanket or lining right round the shield, and in the space left by the wall of the shield between the outer surface of the tunnel and this clay the grouting was forced. The clay also formed an effective air seal at the rear of the shield at the place where it covered the last erected ring of segments of the tunnel. The ballast face was timbered with horizontal planking packed closely together upon a thick bed or wall of the clay, and arranged by stretchers in two halves across the face, first held up against the shield, and later on held by up-and-down soldiers supported by round hollow steel struts passing through the shield when the latter was driven forward.

The tunnel was constructed in the usual way with cast-iron segments bolted together. Continuous longitudinal joints were made, dressed with a mixture of Stockholm tar and red lead before erection. Iron-rust cement was utilized for calking the joint grooves, which were grummeted where necessary. The grouting forced through holes bored through the tunnel rings to fill up the space occupied by the shield between the tunnel and the soil was composed of blue-lias cement.

Owing to the extreme care that had to be constantly exercised, boring through the sand and gravel was not sc rapid as it had been through the more solid clay, but an average daily progress of three rings of 18 inches diameter was maintained, which, under the circumstances, was very good. The air pressure maintained was precisely the same as the hydraulic head in the river, varying for the most part from 24 pounds to 32 pounds per square inch, according to the tides. Little inconvenience or sickness was experienced by the excavators while working under this increased atmospheric pressure. From 30,000 to 200,000 cubic feet of air at atmospheric pressure was pumped through the tunnel per hour, and the proportion of carbonic acid gas in the space in which the excavators were at work varied from 0.06 to 0.10 per cent.

THE WORKMAN EXPEDITION TO THE HIMALAYAS—AN ALTITUDE OF 23,394 FEET REACHED.

The expedition organized by Dr. William Hunter Workman to the Northwest Himalayas has returned after attaining a record altitude of 23,394 feet. The party comprised Dr. Workman, his wife, two guides, Mr. E. Hewett, of London, who accompanied them in the capacity of topographer, and a number of coolies. The expedition was highly successful, and the fruits of the work have added considerably to our present knowledge of glacier phenomena and topographical, geological, and scientific features of this extensive range of mountains.

By the middle of June the party had reached the Hoh Lumba glacier, which lies between the Hispar and Chogo Lungma glaciers. This glacier was traversed throughout its entire length. Near its middle point it is bifurcated by a sudden mountain projection, the two branches of the glacier being of similar sizes and lengths.

One branch, which appeared to be the main portion, rises in a snow *col* 18,600 feet high, crowned by a huge cornice projecting over a towering precipice of between 6,000 and 7,000 feet on the side toward the Hispar glacier. An inaccessible seracked icefall drops from this *col* to the Hoh Lumba glacier.

To gain this *col* was an extremely difficult task. Owing to the heat of the midday sun which melts the snow, avalanches are frequent during the afternoons. This fact rendered it necessary that the ascent should be made in the early morning.

The party started at daybreak to essay the laborious task. First there was an immense bergschund which had to be negotiated, and the climb was over a succession of ice slopes rising at angles of 60 deg. and covering the shoulder of a mountain above a high precipice. The climb was successfully accomplished in five and a half hours, the party attaining the crowning cornice by 10:30 A. M. As further progress was rendered impossible by the precipice, the members of the party secured a series of photographs and other data and then descended.

The second branch of this glacier, which is called the Sas Bon, terminates in a similar *col* and cornice of approximately the same height, also with a precipice toward the Hispar glacier. Some sharp slopes in this case also had to be climbed in order to reach the top, the party often wading waist-deep through the soft snow. As a matter of fact, the snow was the only serious difficulty with which the expedition had to contend. This abundance was due to the abnormal falls that had accompanied the violent and numerous storms of last winter, and also those of June and July. Even the camps had to be pitched in deep soft snow on the glacier.

The expedition made another ascent of the Chogo Lungma in July, and established themselves at the same camp which had constituted their headquarters in 1902. This camp was built on a rock promontory some 14,000 feet above sea level. The violent weather considerably handicapped the explorations of the party, since there were only two or three days during the month when snow did not fall. The party proceeded along the upper southwestern branch of the Chogo Lungma, which lies at a high elevation completely covered with snow, and swept on both sides by avalanches. After completing this task they directed their efforts to the investigation of the three snow peaks which encompass the glacier, and which tower from 17,000 to 20,000 feet in height.

In order to carry out this part of the work, three light camps were made. The first was situated on a smaller glacier at the base of the snow slopes which rise toward the first peak at an elevation of 16,200 feet, the second on a small snow plateau at 18,600 feet above the lower slopes, and a third was at a height of 19,355 feet at the foot of the third peak. It was found impossible to establish a higher camp, because the coolies attending the party became afflicted with *sorochté*, or mountain sickness. They could not be persuaded to climb any more; and perforcedly the last climbs had to be carried out from this camp.

Dr. Workman, in company with his wife and the guides, set out at 3 o'clock in the morning. The thermometer stood at 15 deg. Fahr., and they had to wind their way up steep snow slopes, which at places were of a zigzag nature, and inclined at upward of 70 deg. It was a very laborious climb, but at 7 o'clock they gained the summit of the first peak, which is a curling cornice. The temperature was 16 deg. Fahr. and the height 21,770 feet. A short stay was made here to enable barometric, hypsometric, and thermometric surveys to be carried out. These readings accomplished, they continued their way toward the summit of the second peak, which was connected to the first one by a snow *arete*. At 10 o'clock the party stood on the summit of the second peak at an altitude of 22,567 feet.

There only remained the third peak to climb, which, if the Indian Trigonometrical Survey is to be believed, is 24,486 feet in height. This is joined to the second peak by a rising snow plateau. As the party was somewhat fatigued by their climb of seven arduous hours, all hope of reaching the summit of the third peak that day was abandoned. Furthermore, it was recognized that if the summit were ever to be gained, it would be necessary to pitch a camp upon the snow plateau, which was at an altitude of 22,000 feet. The difficulties of this proceeding, however, were soon apparent. The coolies, owing to their affliction with mountain sickness, would on no pretense ascend to a greater altitude, while it was additionally dangerous owing to the unpropitious weather which was prevalent.

Dr. Workman, however, observed that there was a point about 1,000 feet higher on the southwestern *arete* which afforded a finer view of the valleys toward Hunza; and as Mrs. Workman was somewhat tired with her already tedious climb, he set off himself with the two guides. The climb was a sharp one up steep snow slopes, but the *arete* was gained at 12:30 P. M. At this point a series of calculations founded on the barometer and hypsometer readings taken here, together with those secured at the same hour of the mercurial government barometer at Skardo, showed that the altitude attained was 23,394 feet, some 300 feet higher than the summit of Aconcagua. This remarkable achievement of Dr. Workman creates a new record in mountain climbing, as the record has hitherto been held by those who had gained the summit of Mt. Aconcagua. It may be mentioned also that on this same day, in connection with this identical climb, Mrs. Bullock Workman, who is an expert mountain climber, broke her own and all other women's records. Hitherto her highest ascent had been that of the Kaser Gunge, 21,000 feet, which had been excelled on this date by the climbing of these two peaks by 770 feet and 1,567 feet respectively.

It was a momentous accomplishment, and one that had been accompanied by considerable danger and hard work, as the whole of the ascent had been carried out on ice and snow, which in some places proved exceedingly dangerous.

After returning to the lower level once more, the expedition next directed its steps toward the exploration of the Balucho Glacier, which is a large branch of the Chogo Lungma. During this part of the work a snow pass was discovered at a height of 17,000 feet which led to the Kero Lungma. A cornice on the brow of this pass was cut away to allow of the passage of the caravan of the expedition, which was led down a steep avalanche-gullied snow wall falling away for 1,000 feet to the glacier below. This task occupied four hours. They next followed the Alchori glacier, which is the largest branch of the Kero Lungma, continuing their journey right up to its source. It terminated at the head in a steep rock of a snow *col* 18,200 feet, and this was ascended by Mrs. Bullock Workman and her guides. This *col* overlooks the Hispar glacier, to which it falls away precipitously for several thousand feet. With the exception of the Nushik La, the party found no possible passage to Hunza in this region.

Throughout the whole of the expedition, hypsometer, barometer, and thermometer readings were constantly taken, together with readings of the sun temperature, by means of the black bulb thermometer. At Skardo. also, temperatures and readings of the government mercurial barometer were taken three times every day, by the official stationed there, for the purpose of calculating the heights. Numerous interesting and striking photographs were also taken, and several surveys made in connection with the phenomena of the movement of glaciers, to our knowledge concerning which Dr. Workman will contribute considerable valuable data as a result of his daring enterprise.

SCIENCE NOTES.

The University of Chicago has received valuable concessions from the Sultan of Turkey in connection with the exploration of the neighborhood of ancient Babylon.

Chauveaud calls attention to the presence of laticiferous tubes, some simple, others branched, in the liber of conifers, while the resinous fluids are poured out of the cells in which they are formed, with intercellular resin-canals; the latex remains within the cells. The laticiferous tubes are specially seen in the young seedling plants.—Comp. Rend.

Dr. Frank Irving, chief of the X-ray department of the Newark City Hospital, has exploded the story alleged to have been circulated by a local physician to the effect that the X-ray would slaughter mosquitoes and other insects, and as a result of which Dr. Irving has received a number of letters asking for information.

A new apparatus, of French origin, is based upon the evaporation of formic aldehyde. The solution of formic aldehyde is boiled in a vessel heated by a spirit or other lamp, the escaping vapors being led through a tube made flexible, so that it can be passed through the keyhole of the door of the room to be disinfected. A gage shows the level of the liquid, and scales are provided to show the amount of liquid to be evaporated to disinfect the room properly.

Prof. Munsterberg's mission to Germany to secure the attendance of German scholars for the congress in connection with the St. Louis Exposition has been most successful. Two-thirds of all those invited have accepted. The attendance of scholars from Germany will be larger than from either France or Great Britain. The German government is heartily co-operating in the efforts to secure a good attendance from that country, and Emperor William has expressed the keenest interest in the congress.

It has been maintained repeatedly by G. Bertrand that arsenic, like carbon, sulphur, and phosphorus, is a constant constituent of the organism. He now finds (Annales de l'Institut Pasteur) that all parts of the hen's egg contain appreciable quantities of arsenic, the yolk containing the greater part. In the 1-200 of a milligramme found in one egg, from one-half to two-thirds is found in the yolk. The enveloping membrane contains almost as much arsenic as the white. These observations confirm the supposition as to the existence and the probable rôle of arsenic in all living cells.

An Italian has invented a saturation hygrometer which may be used for determining the tension of aqueous vapor in the air in small spaces, such as instrument cases. A portion of the air to be examined is withdrawn and saturated with aqueous vapor, and the increase of pressure thus caused is noted. Knowing the saturation vapor pressure, it is possible to deduce the aqueous vapor pressure of the experimental air. The apparatus consists of a bronze receiver fitted with a thermometer. Into the receiver passes a glass tube drawn out at the lower end, and connected at the upper end with a spring which serves to force in drops of water. The receiver may be put in communication with the exterior air, and carries at the side a graduated tube of 3.2 millimeters diameter, containing a column of petroleum 2.5 centimeters long.