Talks on Astronomy

The Results of the Canadian Expedition to Test the Einstein Theory

By R. K. YOUNG, of the Dominion Astrophysical Observatory

The organization of the Canadian expedition to Australia and an account of the apparatus and the success of the expedition, has already been published in this paper. Upon the return of the expedition to Canada in November, 1922, Dr. Chant entrusted the measurement and reduction of the Einstein plates to the writer. The University of Toronto possessed no suitable measuring engine. The purpose of the following article is to explain as simply as possible the methods of measurement and reduction of the plates taken in Australia and to present the main results.

According to the theory of Einstein, the rays of light from any source, such as a star, when passing the sun are subjected to a gravitational pull and are bent inwards, the amount of the bending being greater for rays close to the sun than for those farther out. In consequence of this deflection of the light rays the stars in the neighborhood of the sun should appear displaced outward from their normal positions. The displacement varies inversely as the distance from the sun. For stars at the limb of the sun the deflection amounts to 1.75 seconds of arc, for stars about 16 minutes away from the sun it is only half this value, for stars 32 minutes away a third, and so on. Stars in the neighborhood of the sun can be photographed during a total eclipse of the sun, at which time the disk of the moon covers up the bright surface of the sun, and the sky around the sun is comparatively dark. Two exposures were made at the eclipse, and on each of these negatives appear the moon's disk, the corona and about twenty-five star images. However, some of these images are very faint and only 19 were subjected to measurement and three more were rejected later.

Points of Observation

In order to test the positions of the stars on the plate for shift it is necessary to have additional photographs of the same region taken with the same camera when the sun is not in that part of the sky. These should be taken under as nearly as possible the same conditions, the same position of the telescope and at the same station. It was impossible to secure these in the present case as the northwest coast of Australia is a very inaccessible shore with no facilities for living, and it would have been necessary to proceed there several months in advance. The idea that check plates of the eclipse region could be secured almost as well, if not equally as well, on the island of Tahiti occurred to Dr. W. W. Campbell, the leader of the American Expedition. The reason that plates taken at Tahiti serve is that Tahiti has almost the same latitude as the eclipse camp at Wallal, and if the plates are taken at the proper time or hour angle the displacement of the positions of the star images due to refraction are almost identical in the two cases.

Dr. Trumpler of the American Expedition proceeded to Tahiti several months in advance of the eclipse with the cameras of their expedition and secured these very essential photographs. As explained by Dr. Chant in his account of the expedition, Dr. Trumpler took exposures of the same region with the Canadian party's camera, which was shipped to Tahiti for the purpose and designed so that an attachment would adapt it for the Lick Observatory mounting. In addition, Dr. Trumpler secured for us a plate of the eclipse region taken through the glass, i.e., with the glass side exposed towards the lens. The purpose of this plate will be explained later.

We have then five plates to proceed with in the measures, two plates taken at the eclipse camp with the corona and surrounding stars, two plates of the same region when the sun is absent and one plate of the same region taken through the glass. We designate these E, E3, C, C3 and I respectively.

Difficulties of Test

To the novice it might appear very simple to test the position of the images on these plates. He might suggest the superposition of plate E on C, and by direct inspection imagine he could detect the shift. There are many factors which prevent such a direct test. In the first place E and C, being both negatives can only be superimposed film to glass and in this position, with the thickness of the glass between the two films, the relative position of the star images depends on the position of the observer's eye. To overcome this difficulty the plate I was taken. When this plate is placed film to film with any of the other four plates the star images appear in pairs. It would not do to assume that the images on I are in their normal positions, for the light in passing through the glass may have been, and undoubtedly was in some cases, bent from its normal course. The resulting position of the image would be in error. Even if this were not the case the procedure would not do, because the displacement due to the Einstein shift is only a very small fraction of the diameter of the images and the images might appear superimposed when in reality a small shift was present.

The correct procedure is to clamp the two plates firmly together by means of suitable clamps, the plates being so placed that the pairs of images are reasonably close together all over the plate and then to measure the relative positions of the pairs of images, and from a discussion of these measures to ascertain the correct positions and the displacements governing them.

Systems of Measurement

On the measuring engine at the Dominion Astrophysical Observatory, which was made by Repsold, the relative positions of the two images are measured in rectangular co-ordinates, Dx and Dy being obtained for each pair of stars. The plates were first securely clamped together and then measured in both the direct and reverse positions by myself and afterwards by Mr. Harper, to whom we are much indebted for this valuable assistance. From five to eight readings were taken on each image and in both the direct and reverse directions and by each observer. The mean of our values was adopted as the measured Dx and Dy. This work was carried through for the combinations E to I, E3 to I, C to I and C3 to I. It will be obvious even to those unacquainted with such work that the relative positions of the images on E to C are given by the differences E, I—C, I and of those in E3 to C3 by E3 I—C3 I, so that in the discussion which follows we will imagine this difference always taken as if E had been compared directly with C, and E3 with C3. When we examine the Dx and Dy for the various stars we find that they are not equal all over the plate. Let us inquire why this is so. The first reason that occurs to us is that the position of each star image on the photographic plate is affected by atmospheric refraction. The effect of refraction is to make the position of each star appear nearer the zenith of the observer than it really is. The amount of the shift is greater for stars nearer the horizon than for those higher up. The stars on one side of the plate will be shifted more than those on the other side, and while the effect is present on both the eclipse plates and the Tahiti plates and in general to nearly the same extent, there is a small secondary difference, because the latitude of Wallal and Tahiti are not exactly the same and because the plates were not taken at exactly the same zenith distance.

The correction for refraction is one that is capable of computation and can be allowed for. There is also an effect due to aberration of light which can also be computed, and we will imagine that this computation has been performed and each Dx and Dy for each star image corrected. We will still find that they differ for the various star images. These differences depend on the manner of superimposing the plates and on the shifts of the star images, due either to change of scale or to the Einstein shift, and the problem is to sort out the causes of the observed values of Dx and Dy.

We will make the nature of the problem clear by means of diagrams. Suppose we have two star plates, the first with the sun in the centre and star images situated farther out. Let the star images lie in circles, one circle close in to the sun, one a little farther out and one still more remote. On the actual eclipse plates the nineteen images are situated irregularly over the plate, but it will help understanding the method if on these imaginary plates we suppose the star images to be situated in standard positions. Suppose the second plate an exact duplicate of this with the sun image left out. If these plates are superimposed and the centres shifted a little to one side we would obtain pairs of images as in figure 1.

Fig. 1

Diagram Illustrating Star Plate, With Sun in the Centre and Star Images Farther Out, Lying in Circles, One Close to the Sun, One Farther Out, and One Still More Remote

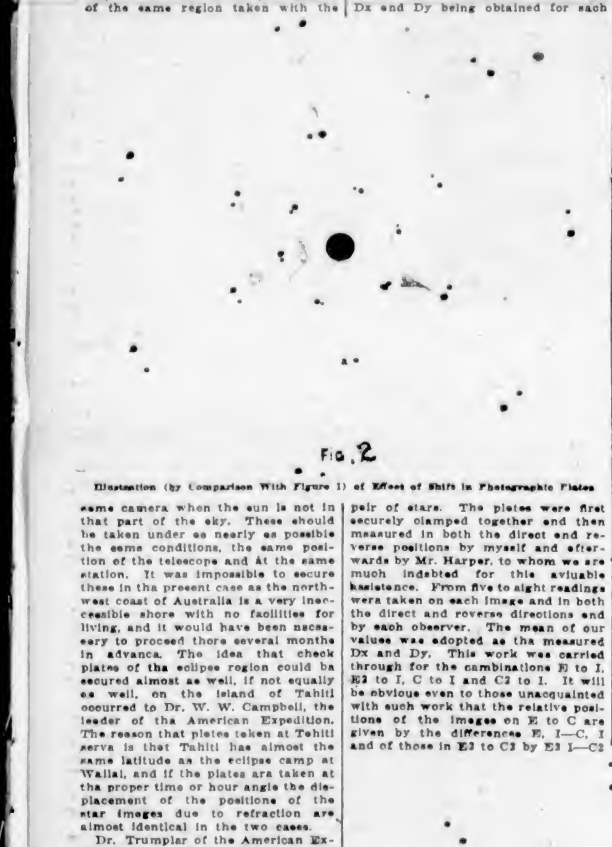

Fig. 2

Illustration (by Comparison With Figure 1) of Effect of Shift in Photographic Plates

In this case the Dx and Dy would be the same for each pair of stars. Let the shift be e in the x co-ordinate and f in the y co-ordinate. In addition to the two plates being shifted it will always happen that one is twisted a little with reference to the other. The nature of the shift that would occur in the relative positions of the images due to this cause is illustrated in figure 2.

The outer images are shifted the farthest, the innermost ones the least. The amount of the shift is proportional to the distance of the star from the centre of the plate. If we let b be the displacement of the image due to this cause at unit distance, then the displacement at a distance r is br, and it may readily be shown that the displacement in the x direction is by and in the y direction -bx. Since we are measuring the two co-ordinates independently, however, let b be the constant for the x direction and d be that for y direction. When these are finally determined b should equal -d. The two preceding causes for displacement depend upon the superposition of the two plates. In addition it is quite possible and indeed almost certain that the two plates are not quite the same scale. That is, one plate will be a little more enlarged or reduced than the other. It must be remembered that one plate was taken in the night and the other in the daytime. Temperatures, barometer and focus would be different in the two cases. The manner in which this factor would displace the images is illustrated in figure 3.

Again it is the outer star images which are affected the most. The displacement is again proportional to the distance from the centre of the plate, but if we compute how much it is in the x and y co-ordinate we would find that the displacement in the x direction is ax and in the y co-ordinate ay, where a represents the displacement of a star due to this cause at unit distance. As before we will introduce two constants, a in the x co-ordinate and e in the y co-ordinate. In the final solution a should be equal to e.

If the Enstein theory is true there should be in addition a displacement of the star images outward from the sun which operates in the same sense as a scale correction. The amount, however, at various distances is not the same as that due to scale. Whereas the scale correction affects the outer stars the most and the stars nearest the sun the least, the Einstein effect is just the reverse, affecting the latter the most and those farthest out the least. If A is the displacement due to the Einstein effect at unit distance from the sun, then the displacement in the x direction of any star whose co-ordinates are x and y is a function of x and y times A or A.Ex and in the y direction A.Ey where Ey is another function of x and y.

Fig. 3

Displacement of Star Images Through Additional Factors, Such as Temperature, Barometer and Focus

The observed differences Dx and Dy are a combination of these various factors which combine linearly, that is to say, each measure for a star leads to two equations of the form

$$ex + by + o + AEx = Dx$$
$$dx + ey + f + AEy = Dy$$

In these equations e, b, c, A, d, e, f are unknowns, x, y, Ex, Ey can be either measured or computed and Dx and Dy are the results of measurement. If we measure 19 star images we obtain thus 38 equations to determine 7 unknowns. In such cases there is a mathematical process known as the solution by the method of least squares which enables one to find the most probable values of the unknowns.

When this calculation was performed it was found that the value of the Einstein constant came out about 1.30 seconds of arc, almost the value predicted by Prof. Enstein.

It may be remarked that we have followed pretty closely the method of solution adopted by the English astronomers, for the eclipse of 1919 as given in the Smithsonian report for 1919, pages 133-176. This method presupposes the existance of the Einstein term. The reader will be able to see from diagrams that the constants a, b, c, d, f are determined principally from the outer ring of stars. An alternative method of solution would have been to have used these to determine the plate constants and then computed the most probable value of the Einstein constant from the residuals left by the inner stars. This procedure theoretically has something in its favor, but when the number of the stars is fairly large the two methods must yield almost identical results.

To Honor Memory Of Mr. Goodyear

Charles Goodyear, father of the rubber industry, is to have a monument in the United States. There was rubber long before Charles Goodyear was born in 1800, and it was put to a variety of uses, but there was no vulcanized rubber. Nobody had discovered a process whereby rubber could be hardened without losing its characteristics; nobody dreamed that vulcanized rubber would assist in the revolutionizing of many industrial processes. Goodyear, at the time he turned his attention to rubber, was as unlikely a prospective father of a great industry as could be imagined. He was in New York and "broke." He had worked in a hardware business in Philadelphia, but the commercial crisis of 1830 wrecked the firm and he had to look for employment. At that time its gummy adhesiveness was the great drawback to the use of rubber, and Goodyear, who was of an inventive and improving turn of mind, saw that if this defect could be removed there would probably be a fortune for the discoverer of the process. Pitifully short of funds, he set to work, and by means of nitric acid succeeded in getting rid of the surface stickiness of the rubber. Beneath the surface the old defect remained, but, nevertheless, there was an immediate demand for the Goodyear kind of rubber, and a plant was established in Rhods Island which turned out great quantities of footwear, and rubber in other forms.

Goodyear was far from satisfied with his product, and continued to experiment. In 1839 by a mere accident he made his great discovery. While being treated with a sulphur process, a piece of rubber came into contact with a red hot stove. When he picked it up he saw that a remarkable transformation had been wrought. The rubber had become hardened all the way through, the interior gumminess having vanished. Otherwise it was just the same. It had lost no single valuable property. It remained pliable and elastic. Goodyear at once began to obtain furnaces to produce a high degree of artificial heat to his rubber, and applied for patents on his discovery. Unfortunately, like most inventors, he was deprived of a great share of the profits that should have come to him. France refused him patents and appropriated his invention. An Englishman got hold of some of his vulcanized fabrics and also the specifications in his application to the French patent office, and secured a patent in his own name in England. Goodyear, however, did not die in poverty, though undoubtedly his later years were embittered by the thought that the rich rewards that should have been his had been meanly appropriated by others. Now that he has been dead more than sixty years he will have a monument acknowledging that on the whole he was unfairly dealt with, and that he was one of the benefactors of mankind. The city in which he invented the nitric acid process, the city where he made his accidental discovery, the city where he lived at the time of his death, and the city which is now recognised as the centre of the American rubber industry, all are competing for the honor of being known as his home city. Even London is contemplating a memorial, a fact that causes The New York Herald to comment rather sardonically on the fact that though the United States uses nearly three-quarters of the world's entire rubber output, it is dependent upon a foreign monopoly for its supply.—Mail and Empire.

Killing Sympathy

Apart from the few fanatics who have made a fetish of the reopening of formal relationships with Russia, there is not a trace remaining of such public sympathy as formerly favored that idea. The Bolshevik campaign against Christianity and religion in general has killed the last of that sentiment, such as it was; and the practical reasons which used to be adduced to support it, based upon the idea that Bolshevism, for better or worse, had established itself as a permanent regime, have dissolved into mere absurdity in face of the plain facts.—London Daily Telegraph.

Cuno's Wrong Idea

Cuno, the German shipping king, and Chancellor in his spare time, says that if any other nation were treated as Germany is, the world would "seathe with indignation." But what other nation would permit itself to deserve one-half as much? As the Germans made their bed, why should they lie about it?—Montreal Gazette.

Nearly 4,000,000 people live within New York's 318 square miles of land area.

Mystery of Ancient City of Ur

R. CAMPBELL THOMPSON, IN LONDON TIMES

Nearly two hundred miles southeast of Baghdad, out of the flat Mesopotamian desert in a land of contrasts, where the grim heat of Summer challenges the cold of Winter and flooded rivers mock the scorched plains, rises the poor rain-gnawed ruin of the untented desolate tower of the ancient temple of the Moon at Ur.

Four, nay, five thousand years ago Ur was a queen of the cities south of the great Euphrates' lagoons where the river channel loses itself in the shallows, and the sea-tides ebb and flow past the brakes of cyperus-reeds. Her proud zigurrat, a massy pinnacle of crude adobe faced with burnt bricks stamped with their Royal maker's name, stabbed the blue of the sky, "like a dagger-point," as the old Assyrian historians would have said, and from its summit the watchmen overlooked the close-packed flat roofs of the city below, which was even now built high on the mound of ancient middens left by their forbears, girt in a two-mile circuit. Beyond the safety of the mound itself a network of parasite houses stretched to the northward, clustering round the city's skirts for all the advantages in protection, traffic, fellowship, which they might thus win.

Away to the southwest twelve miles across the shimmering levels lay the famous but small township of Eridu, with its shrine to Enki, the god of the waters, visible from Ur when the mirage allowed; in the far distant north lay larger towns, threatening war at times, Ersch, Lagash, Larsa, Isin, even up to great Babylon, all beyond the river arms. Palm-belt, pasture, and cornfield, which marked the natural wealth of Ur, were fed by the Euphrates itself, here so broad that those poets who could write called its great lakes the Sea; and, where Euphrates could not reach, canals kept clear of weeds by Royal command bore Enki's bounty to the crops. Beyond the pale of cultivation lay the dun-colored desert where the devils lived, part sand, part alluvial soil, here and there streaked with thin-spread salt, and in Spring picked out with little purple irises, where, if Adad, the god of rain, had been kindly, the thirsty barrenness turned to grassy pasture. Where the Cornishman toasts Fish, Tin and Copper, the Chaldean might well vaunt instead his Fish, Dates and Corn.

First Excavations

In 1625 Pietro della Valle, a Roman gentleman of courage, set forth from Basra with a caravan going to Aleppo, and on his way he visited the great mound of Ur.

"What it had been I could not understand; but I found it to have been built with very good bricks, most of which were stampt in the midst with certain unknown letters which appeared very ancient. I observ'd that they had been cemented together in the Fabrick, not with lime, but with bitumen or pitch, which, as I said, is generated in these Deserts; whence the Hill upon which these ruins are, is call'd by the Arabians, Muqeijar, that is, pitchy."

He is quite correct. It is called so to this day, for this reason.

In the Winter of 1853-54, J. E. Taylor, the British Vice-Consul at Basra, began the first excavations on the site. It was a period when Layard and Rawlinson were making their great discoveries, the former by his excavations at Nineveh and Kaleh, the latter by his brilliant decipherment of cuneiform, and naturally the interest of many was drawn to any site mentioned in the Old Testament in the hope of "proving" the Hebraw Scriptures.

He began with the zigurrat, clearing much of it, and finding four perfect clay cylinders inscribed in cuneiform, which Sir Henry Rawlinson subsequently read, showing thereby that Taylor had found a temple to the Moon, and that the city was Ur of the Chaldees. Close to its southeast corner, 45 yards distant, he discovered another building, 400 yards round, paved with kiln-burnt bricks in bitumen, the walls made of crude brick, and the rafters evidently of date-palms; but, except a few copper nails, the building yielded little. He was more successful in clearing what he calls the Tomb Mound, a little to the south of the zigurrat, which he found to be full of pottery coffins, containing skeletons and funerary utensils, which appear to date from C. 200 B.C. onwards, perhaps even to a very late period. He refers to the "enormous quantity of sea shells found all over the ruins and in the graves"; he found no glass, but plenty of copper.

Encouraged by his success here, the next season he pushed still farther into the desert, to the lonely mound of Abu Shahrain (Eridu), which lies some twelve miles to the southwest of Ur, and although he is so modest as to say that his visit was unproductive of any very important results, I, for one, am not going to agree with him. Eridu, in spite of its smaller extent, has this advantage over Ur (so it seemed to me)—that its surface is still covered with prehistoric remains, for the good reason that serious occupation probably did not continue there after (say) 2000 B.C.; while at Ur, on the other hand, the superficial traces are of much later date, the work of the older people having been destroyed by their descendants. The contract-tablets found by Dr. Hall show that business was carried on at Ur down to the late Babylonian kingdom, and therefore there must always have been some population. Besides, Nabonidus, who, like Mr. Hardcastle, liked everything old, in his piety towards the Moon-god, restored his temple at Ur and installed his daughter therein as a priestess in the sixth century B.C. It is this very point (that the later populations gradually stamped to dust all superficial traces of their prehistoric forefathers) which makes it essential to compare the excavations at both cities.

War-Time Digging

From Taylor's time onwards I believe no excavations at all were carried on in the Ur district until the Spring of 1918, when I was serving as a captain with G.H.Q. at Baghdad, and was ordered to make an archaeological exploration in the south for the British Museum, who were anxious to take up excavations again in these parts.

Naturally, Ur and Eridu appeared the likeliest spots to excavate, particularly the former, which was not far from the railway, and was well within our "protected area." But Eridu, shrouded in an alluring mystery, and for that reason more attractive than Ur, was "out in the blue," twenty miles from the nearest mobile force, and far from any habitation where diggers might be found. Its distance, and the problem of obtaining water, food, fodder and fuel, especially in war time, were not encouraging, and never did I so thoroughly appreciate Taylor's work. However, the Civil Commissioner, now Sir A. T. Wilson, never at a loss for ways and means, and very ready to further the British Museum's wishes, set about solving the problem of finding diggers and everything else, and, meanwhile, I spent a few days in making trial pits at Ur and riding down to Eridu on a flying visit.

Short though my diggings were at Ur, they showed that in part of the mound at least the strata of the third millennium B.C. lay close to the surface. At eighteen inches depth we found a "mat-burial" of a woman with her funerary pole, nose-ring and armlets, which may be very approximately dated at 3300. A "throwout" near contained a couple of "schoolboy" cuneiform tablets of about the same date. The surface, as Taylor had also found, appeared to be honeycombed with tombs, frequently of the "bathtub" variety (larnakes). But most interesting of all were the rare but definite traces of primitive man: a few flint flakes, a very few small fragments of pottery painted in geometrical patterns, and a piece of a clay sickle, such as I was to find later at Eridu in large quantity, and, as I have mentioned above, were found by Taylor.

Hamud, the sheikh of the district in which Eridu lies, in obedience to Wilson's summons, suddenly appeared one morning with fifty Arab scallywags for work, and we left Ur as soon as we could for the southern site. With me was my Irish batman Thomas Higgins, whose native wit was quick to see a silver lining in the cloud of minor camp disasters, and no matter how fiercely it scorched, thundered, or hailed, he was always ready with his anthem of praise to Adad, the storm-god, giving thanks for the end of a perfect day.

Eridu Pottery

Taylor's description of Eridu is correct. The site was covered with clay sickles, flint implements, and other prehistoric relics. But naturally he had no means of identifying the most important point of all, the pottery, and since in those days pottery fragments were reckoned of little value when compared with winged bulls, the importance of these painted sherds which lay scattered about was ignored. But these delicate fragments of pots, not turned on the wheel, but painted in geometrical patterns, were exactly of the same kind as the beautiful pottery found by De Morgan at Susa, in Elam, over the Persian border, throughout a stratum of nine metres in depth, which lay fifteen metres below the surface, i.e., at the lowest level, twenty-four metres. It was a delightful surprise to find them, for hitherto Mesopotamian diggings had shown almost nothing of the kind from the earliest Sumerian period. The obvious inference was that the earliest occupants of South Babylonia were the same as those of Elam, who, from a comparison of their potsherds with the much ruder pot-decorations discovered at Anau by Pumpelly, have been very reasonably supposed to have migrated westwards from Turkestan. I am inclined to think also that this painted pottery from Eridu is strong evidence that the Sumerians were of a different race from these first-comers in Babylonia.

I had a series of test-trenches dug, in some cases down to what almost certainly is virgin sand, and these showed how this pottery at Eridu was coeval with the stone hoes, flint chips, and clay sickles; it was also clear that these four classes of relics must have been used on the site long before the introduction of copper. The evidence which this quantity of prehistoric objects affords can be applied to the story, but convincing, primitive traces of the same kind which I had found at Ur, obviously another site which the same early people must have occupied (Archaeologia, Vol. 70, 1918-20, 101 ff.). Specimens of these finds are now exhibited in the British Museum.

Another result of the new Eridu diggings came about in a curious way. In many of the strata, down to early in the prehistoric period, were numerous mussel shells, doubtless from the menu of the primitive folk. After I had brought them home Mr. Bullen Newton identified them as freshwater mussels. It was a point which abolished the old belief that Eridu was on the shore of the sea in those early days: the water which undoubtedly came near to it, from the legend of Adapa) must have been the Euphrates swamps.

Dr. Hall's Success

After my return my former colleague, Dr. (than Captain) H. R. Hall, of the British Museum, was sent out by the trustees in November. He reopened the diggings at Ur, where he met with success, finding a palace of Ur-Engur and Dungi, kings of the Third Dynasty of (Ur, C. 2450 B.C., which he carefully cleaned. Traces of fire everywhere showed how the building had been destroyed, probably at the fall of the Dynasty in 2357. On its ruins, perhaps long after the debacle, he found the circular bread-ovens, apparently just such as bake the flat pancakelike bread in Bashra today, the washplaces, and the domestic remains of the houses of priestly families. Less exciting (and, therefore, all the more admirable) was his work in clearing one side of the zigurrat; it was probably more amusing digging out the cellars of the temenos-wall of the Temple of the Moon. With all this work on hand he found time to dash down to Eridu, and add to the prehistoric collections from there; but the best achievement of his campaign was his discovery at Tell el-Obeid.

His attention was drawn to this mound, which lies about four miles west of Ur, when he was examining the desert on that side. He found it covered with the same kinds of prehistoric antiquities as had come from Eridu — decorated pottery, flints, sickles, etc.—and he began work there. His energy was rewarded shortly by a platform of unburnt brick, probably at Dungi, C. 2450, beneath which in a ruin of pre-Sargonic work (C. 2900) he found a mass of twisted copper, the remains of several lion heads in that metal, two panther heads, and similar remains, several of which are now exhibited in the British Museum. But the greatest find of all was a copper relief, 8 ft. by 3½ ft. in size, representing the lion-headed eagle of Lagash, holding two stags by their tails. It was a most artistic conclusion to a successful dig.

Meanwhile, the diggings at Ur continue under Messrs Woolley and Smith. It will be, above all, interesting to see what their lower strata show; for there can be no doubt that Ur, Eridu, and Tell el-Obeid were once occupied by the same primitive people who left their relics in the lowest strata of Susa.

Labor Still Rules Queensland State

From London Times.

Labor has won a comfortable victory in the Queensland elections, and those who had hoped to see retribution fall upon the Government for the revolutionary legislation of the last few years have suffered a sad disappointment. An article from our Melbourne correspondent, which appears in another column, describes the experiments in legislation practised by Mr. Theodore and his colleagues since Labor came into power in 1915. By a piece of the most unscrupulous party tactics the Government was successful in securing the abolition of the Upper House, which had acted as a brake upon Labor's over-exuberant efforts to revolutionize the political and industrial being of the State. It essayed expensive and unsuccessful adventures in the State ownership of meat works, fish shops, and timber yards, for which the people of the State duly paid. It used the Railway Department as a haven of refuge for those of its supporters who happened to be unemployed; and, as owners of Queensland properties who are resident in this country are aware to their cost, it introduced legislation whereby pastoral leases held from the Crown were repudiated and assessments subjected to the most arbitrary revaluation.

It is small wonder that the Government earned a doubtful reputation even in a Dominion schooled to the eccentricities of Labor politicians. It was confidently predicted, moreover, that at the first opportunity the electors of Queensland would declare for an administration possessed of a higher degree of responsibility. Now the opportunity has come and gone, and Labor has re-entered Parliament with a considerably strengthened majority. Apparently it has been the familiar story of a solid Labor block opposed by several forces which, though in agreement as to their repugnance to the policies of Labor, are yet unable to agree as to a common policy of their own. Those who are genuinely concerned for the welfare of a rich State which is possessed of an extraordinary variety of assets—from the rolling pasture lands of the southwest to the tropical fruits of the north—may find consolation in the fact that the experience of Australia has shown that a lengthy term of office generally has a sobering influence upon Labor politicians, and that the cares of administration bring with them a certain sense of responsibility. It is early to make prophecies as to the future plan of action of Mr. Theodore, who, whatever his creeds may be, is, like his predecessor, the late Mr. Ryan, a man of conspicuous intellectual attainments and powers of leadership. Yet the recent Labor Convention at Rockhampton showed him in a new and more favorable light, as a vigorous opponent to those who sought to abolish the machinery of the Arbitration Courts and substitute those dangerously vague "means laid down by the All-Australian Congress of Trade Unions," a body notoriously amenable to the influence of Russian agents. During the last few months the Queensland Government has even made cautious advances in the direction of formulating a practical scheme of immigration. If it awakes to the fact that, to safeguard the prosperity of the workers from whom it holds its mandate, it is necessary not only to attract new settlers, but to protect the much-abused capitalist, whose enterprise has realised the assets of the great spaces "out back," it may yet atone for its ill-considered and ruinous attempts to turn Queensland into a sort of laboratory for Socialist experiments.

CANADIAN FORESTS RECKLESSLY WASTED

Mr. F. J. D. Barnjum writes to The Montreal Star:

"The reason that our pulp and paper mills have not as yet felt the actual imminent shortage of the available pulpwood supply is due to the large amount of cutting that has been done in the endeavor to salvage as much of the two hundred million cords of budworm-killed wood as possible. However, the present year will probably see the end of the salvage period of this dead wood, as it has now largely got beyond a useable condition, and when the operators again look about for a chance to cut in green timber they will then very soon realize that there is an acute shortage in the supply. Notwithstanding this tremendous shrinkage in our standing timber we keep adding to our consumption to such an extent that in a five-year period the increase in Canada has amounted to 100 per cent, and at the same time the loss from fire is also increasing from year to year, and, as the country becomes drier from lack of forest cover, will continue to increase. These vital factors are quite overlooked in estimating how long our standing timber will last. It is the common custom to take the amount of the stand and divide it by the amount of the present cut, despite the fact that the loss from the above-mentioned causes is more than ten times the amount of depletion by the axe, and that consumption is increasing at the alarming rate noted above. When the timber on the steeper mountain slopes, which should never be cut, and also the inaccessible growth is deducted, the available stand of live wood is reduced to a very small quantity. Over and above all this, the most serious thought for our consideration is that our watersheds are already over-denuded of forest growth to such an extent that many of our mills have to operate at half capacity or less for four or five months in the year from lack of power, with alarming freshets in the Spring, causing untold damage, together with severe climatic changes, and an alternating of cold and heat which are disastrous not only to agriculture but to human life as well."

It was not until the nineteenth century that the plague came to India.