MUMMIED HEADS.

HEREWITH are presented four cuts of very strange, post-mortem, artificially contracted Indian heads from Ecuador and Brazil. All have had the bones removed and are mummified to about the size of a large orange; are of slightly aromatic odor and leathery consistency.

The origin of these is somewhat mysterious. They are decidedly scarce, the few that have found their way into museums having for the most part been obtained in or about the town of Macas, at the foot of the

FIG. 1.

Andes—a town which does not at present have any direct intercourse with whites. Those from Macas appear to be larger than the few that have been derived direct from the Indians of the Jivaro tribe.

In the London Intellectual Observer of 1862 Bollaert, who draws his information from a history given by Velasco, says: "Heads of victims are cut off, the skull and its contents removed, and a heated stone introduced into the hollow of the skin. Desiccation goes on and it is reduced to about one-fourth, retaining some few of the features. . . . A double string is attached to the top of the head, so that it may be worn around the neck. The lips are sewn together and a number of strings hung from them, the use of which is not apparent."

In the Journal of the Anthropological Institute for 1874 Sir John Lubbock made the declaration—though upon what authority is not known—that "these heads are boiled for some time in an infusion of herbs, the bones then removed from the neck and heated stones put into the hollow, whereby the head is dried and contracted."

Dr. Page in a recent paper* states, on the strength

FIG. 2.

of "a distinguished anatomical authority in England," that if a dried preserved head be softened, boiled in water, and the bones removed by means of an incision along the occiput, the soft parts will shrink in exactly the same manner as the preserved Indian heads.

The same gentleman gives a list of such heads as he has been able to trace in the different museums of Europe. Besides six that were variously exhibited in

London between 1853 and 1882, there are four in the British Museum; one in Brighton Museum; one at Owens' College, Manchester; three at Cambridge University; one in the Antiquarian Museum, Edinburgh; one in the Edinburgh University Anatomical Museum; one in Dublin University; three in Berlin University; three in the Public Museum of Vienna; three in the Vienna Pathological Museum. The editor of this journal has seen no less than four within the limits of the United States and one in Canada, all in private hands, though it is understood one of these has been donated to the Smithsonian Institution. Some of the heads described by Page do not, however, properly belong to this category, as they are of materially larger size, many containing a considerable proportion of the bony constituents, and the majority lack the thread ornaments which are the characteristics of those obtained from the Jivaros. It must be understood at once that the preserved heads from the East Indies, such as

FIG. 3.

are found among the Dyaks of Borneo and Sumatra, and likewise those derived from the Manchurucos of Brazil, are of entirely different character from these herein illustrated, and in great part retain their natural size.

Besides the list given by Page, we are informed there are several in Italian museums—four or five—and three at Madrid; there was also one—that probably pertains to the list given by Dr. Page—in possession of the late Dr. Frank Buckland, a facsimile of which appears in Fig. 1.

Of those brought to the United States, four were originally in the possession of Mr. Hassaurek, formerly United States minister to Ecuador, which the writer had the privilege of examining some years since. Mr. Hassaurek is authority for the information that these are not "worn about the neck," neither are they, as has been generally surmised, worshipped as household gods, but obtained by the Jivaros from the huacas or ancient burial places. While they are regarded with considerable reverence, no such superstition attaches thereto as has been commonly credited. It was a Dr. Andrade, curate of the village of Machuchi, who first propounded the idea that these heads were treated as idols, especially implored to keep family secrets, and for every secret intrusted a string drawn through the lips; he is to be credited also with promulgating the belief that they are worn by their possessors on solemn occasions as ornaments. All this is purely hypothetical, without any true foundation.

FIG. 4.

None of the heads seen by us have ever been opened upon the occiput, and only in one or two instances was there a cord through the sinciput for purposes of suspension.

It would seem highly probable that the threads that passed through the lips originally possessed some such significance as the Quippus of the ancient Peruvians, which are said to have been composed of large base cords, to which were fastened in a peculiar manner threads more or less fine and knotted or entwined in

established order for the purpose of expressing ideas, events or numbers. The ancient Peruvians were in the habit of carving in semblance of human form the posts or wooden "idols" (?) which held these registers. The art or science of the Quippu language appears to have been lost to a great extent by modern Peruvians, although it is imagined there are in the southern provinces Indians who understand how to decipher these intricate memorials, but guard their knowledge religiously as a sacred secret inherited from their ancestors.

The configuration of the lips of these mummified heads, the perforations through them—which no doubt date from the earliest history of mummification—strongly suggests a purpose of chronicling history. Something of the same kind was observed of certain of the mummies that have been found of an extinct race that formerly inhabited the Fortunate (Canary) Islands.—The Medical Age.

ASTRONOMICAL WORK AT LICK OBSERVATORY.

By EDWARD S. HOLDEN, Director of Lick Observatory.

WHILE the resources of the Lick Observatory are large in comparison with those of many college observatories, they are very small in relation to those of the great establishments of Greenwich, Paris, Pulkova, Washington and Harvard College. For instance, the whole available income of the Lick Observatory for the coming fiscal year (exclusive of salaries) is \$5,145. This sum must keep all the buildings painted and in repair; keep all our reservoirs and some five miles of underground pipes in order; provide for all painting, plumbing, brick laying, pipe fitting, carpenter work, machine work, etc., in the observatory and in the houses of astronomers and workmen; buy all supplies, such as lumber, hay, iron, brick, etc.; pay for all instrument making not done in the observatory; pay all freight, express and telegraph bills; maintain a telephone line 17 miles long in good order; pay for fuel; purchase books for the library; provide any needed apparatus for all the instruments; and, this year, buy much of the material needed for an eclipse expedition to India. It is no small task to make the small income cover the requirements. Every want which is felt in a large city is felt here. The circumstances at Mount Hamilton are as different as possible from those at Eastern observatories. There each person must provide for his own personal comfort; here the comfort of each one must be secured by the expenditure of the annual appropriation. If it is insufficient, every person suffers in some degree.

The astronomical efficiency of the Lick Observatory cannot be properly estimated without taking such material and social considerations into account. Under the circumstances, I do not think it is too much to claim that its efficiency during the nine years of its life has been satisfactory. This has only been attained by good will and earnest effort on the part of all concerned—regents, astronomers, mechanics, workmen. The summary of work for which you asked is given below.

Double stars have been measured here in past years in great numbers by Prof. Burnham, and at the present time Profs. Schaeberle, Hussey and Aitken are engaged in such work for parts of their time.

The satellites of Mars, Jupiter, Uranus and Neptune have been regularly observed here for the past nine years by Messrs. Schaeberle, Barnard, Campbell and Hussey. A fifth satellite of Jupiter was discovered by Prof. Barnard in 1892.

The planets, especially Mars, Jupiter, Saturn (and also Venus and Uranus), have been systematically observed for their physical features at every opposition by Messrs. Holden, Schaeberle, Keeler, Barnard and Hussey. For several oppositions of Mars the planet has been followed by Messrs. Holden, Schaeberle and Campbell during every available hour.

Comets have been discovered here in great numbers. Ten comets (seven unexpected) were discovered by Prof. Barnard from 1888 to 1892; five (four unexpected) by Mr. Perrine from 1895 to date. The long series of observations of these and other comets by Messrs. Barnard, Campbell, Hussey, Perrine and Aitken are a contribution to science even more important than the discoveries themselves.

Comet orbits have been computed here by Messrs. Schaeberle, Campbell, Hussey, Perrine and Aitken; and all comets discovered at the observatory have had their first orbits calculated by officers of the university. In this work Prof. Leuschner, of Berkeley, a former student here, and his assistant, Mr. F. H. Seares, have rendered assistance which is much appreciated.

Meteors have been observed and photographed here (and elsewhere) by all the astronomers, and their orbits calculated by Messrs. Holden and Schaeberle.

Double star orbits have also been computed by Prof. Schaeberle.

The zodiacal light was regularly observed (visually) by Prof. Barnard.

The aurora has been regularly observed (spectroscopically) by Prof. Campbell.

Typical or remarkable cloud forms are regularly photographed by Mr. Pauli, janitor of the observatory.

Nebulae have been observed (visually, photographically and spectroscopically) by Messrs. Holden, Burnham, Schaeberle, Barnard and Campbell.

Star maps have been made and published by Mr. Tucker.

Photometry (photographic and visual)—of eclipses and of stars—has been attended to by Messrs. Holden, Schaeberle, Campbell and Leuschner.

Solar Eclipses.—Those of January and December, 1889, April, 1893, August, 1896, have been observed by Messrs. Burnham, Schaeberle, Keeler, Barnard, Leuschner and Campbell, and the latter will observe the eclipse of January, 1898, in India.

Lunar Eclipses.—All lunar eclipses visible here have been observed.

Occultations.—A series of occultations has been observed here by Prof. Leuschner.

Transits of Mercury.—Three transits of Mercury have been observed, either visually or photographically.

Transit of Venus.—That of 1882 was successfully photographed here by Prof. Todd.

* Journal of Anatomy and Physiology, January, 1897.

Catalogues of Stars.—Two such are in progress of preparation.

1. A catalogue of double stars and of coast survey stars from observations by Prof. Schaeberle has been (partly) reduced, on lines laid down by myself, by Messrs. Schaeberle, Campbell, Leuschner, Aitken and Prof. Bigelow and Mrs. Updegraff. Prof. Aitken has spent more than a year on this work.

2. A catalogue of 38,000 stars from Washington observations is well toward completion. The reductions have been made chiefly by Messrs. Holden and Aitken. The original observations as printed were full of errors. The final places will be considerably more precise in declination and somewhat less precise in right ascension than the southern zones of Argelanders.

Solar Photography.—Some 1,800 negatives of the sun (taken with the photoheliograph) have been secured by Mr. Perrine, and since April, 1896, some 450 more by Mr. Colton. Excellent experimental solar photographs on a large scale have been made with the 36 in. telescope, and it is hoped to go very much further with this work during the summer of 1897.

Lunar Photography.—A very full series of local negatives has been made with the 36 inch telescope, chiefly by Messrs. Holden and Colton. An atlas on the scale of X feet to the moon's diameter has been prepared from these by Prof. Weinek, at Prague. Enlargements in the telescope have been made by Messrs. Holden, Colton and Perrine, and 5 plates of a moon atlas on the scale of III feet to the moon's diameter have been distributed. Twelve more plates are now in the hands of the engraver and will soon be issued; and about 20 more are ready to be published when the funds are available. The atlas will be complete with about 60 plates. All the work in the dark room was done by Mr. Colton.

Photographs of the Milky Way.—A great number of such pictures has been obtained by Prof. Barnard, who is preparing them for publication.

Photographs of planets, especially of Jupiter, have been regularly made by Messrs. Holden, Schaeberle and Colton.

Photographs of comets have been secured by Messrs. Barnard, Hussey and Colton.

Visual Photometry.—Two fine photometers of Prof. Pickering's design have lately been given to us by Miss Bruce. They will be used by Prof. Aitken, chiefly on double stars at present.

Spectroscopic observations of nebulae, new stars, comets, stars and planets, have been made by Messrs. Keeler and Campbell. The chief problem of the great telescope is to determine the motion of the solar system by spectroscopic observations. It was first attacked here in 1888, and since that time it has been considered as our most important work. The results now attained by Prof. Campbell are of unexampled precision, and some of them will be published shortly. Many unexpected delays have occurred in this research, which has been under the charge of Messrs. Keeler, Crew and Campbell.

Time signals are sent out daily. Mr. Tucker is in charge of our clocks.

Meridian Circle Observations.—Mr. Tucker has completed a fine series of observations of all stars contained in any of the great ephemerides and not contained in the Berliner Jahrbuch. This work is all ready to print. He has also determined the places of a long list of stars used by Prof. Doolittle to determine the latitude of Lehigh University. The division errors of the 1° spaces of both circles of the instrument have been determined by Mr. Tucker with the assistance of Mr. Aitken.

Meteorological observations (tri-daily) have been regularly made. They are now in charge of Prof. Aitken. A summary of all meteorological observations made here from 1888 to 1897 is in course of preparation by Mr. Perrine.

Earthquake observations are obtained on our two seismographs, which are in charge of Mr. Perrine. A complete list of all recorded earthquakes on the Pacific coast from 1769 to 1897 has just been prepared by Prof. Holden.

Publications of the Observatory.—The observatory has already issued three quarto volumes and five octavos, besides several pamphlets and the Moon Atlas. The Smithsonian Institution has lately published an octavo prepared here by Prof. Holden—Mountain Observations—and will probably print his list of recorded earthquakes, just mentioned. Notices from the Lick Observatory regularly appear in the publications of the Astronomical Society of the Pacific. More than 1,200 contributions to astronomical and other journals have been made by the officers of the observatory since 1888.

Trial of the Crossley Reflector.—This fine instrument, which had done such good work in the hands of Mr. Common, was presented to the Lick Observatory by Mr. Crossley in 1895. It was completely mounted in June, 1896, and given over to Prof. Hussey for trial. The work begun in 1896 is now being prosecuted. Photography in the Newtonian and principal foci will be tried by Prof. Hussey, and Prof. Campbell has a programme of spectroscopic observations to be carried on with the Bruce spectrograph (constructed here) in the principal focus. A powerful driving clock (the Bruce clock) has been made here from drawings by Prof. Hussey. It is essentially a copy, in little, of the Warner & Swasey clock of the 36 inch equatorial. Its conical pendulum weighs about 56 pounds.

The Schaeberle 18 inch reflector has been used for some years past in experiments in celestial photography by its maker, Prof. Schaeberle. Very interesting photographs of Jupiter have been obtained.

The Crocker photographic telescopes (a pair of Willard portrait lenses) will soon be mounted in a new dome near the Crossley reflector. A 12 inch mirror (by Prof. Schaeberle) of very short focus is to be mounted on the same stand.

Lick Observatory, July 7, 1897.

CHEMISTRY AND ARCHÆOLOGY.

THE fact that all the sciences are intimately allied, and that any one of them may be called upon to serve as the handmaid of any other, is once more exemplified by the services recently rendered to archaeological research in France by some analyses made by the eminent chemist M. Berthelot, and described by him in the Comptes Rendus of the Academy of Sciences.

By analyzing the metal of some early implements recently unearthed in Chaldea, he shows that they are pure copper—not bronze, as had been supposed—and throws interesting light on the methods and processes of metallurgy in those early times. The Literary Digest translates as follows:

"The discoveries made in Chaldea, at Tello, several years ago, by M. de Sarzec have made known to us monuments of great antiquity, going back to the origins of civilization, that is to say, five or six thousand years. They have furnished, among other things, arms, ornaments and utensils capable of throwing new light on the origin of the metal industries. Such are the objects deposited in the Louvre Museum, which M. Henzey, my colleague, has submitted for my examination.

"I present herewith the results that I have obtained, which form a part of a methodical series of researches that I have been making for several years on the metals of ancient civilizations. The result has been a distinct advance in our knowledge of these interesting questions. In fact, we have here the earliest and most ancient records belonging to the copper age, whose date is definitely known."

The detailed results of a chemical analysis of various objects found in Chaldea are next given, and it is proved that such objects are practically pure copper, although many of them are labeled "bronze" in the museums. Says M. Berthelot:

"The existence of successive stages in the use and purification of metals, whether common or precious, follows from all these analyses. In particular, the employment of pure copper for making arms and utensils, even of current use, in Chaldea, about 4000 B. C., is established by the analyses. It preceded the use of bronze, that is of copper alloyed with tin, which is found in later objects, in Chaldea as in Egypt. We may even add that the form of doveled axes and the processes of manufacture, as well as the practical uses for which these utensils were destined, were the same for the pure copper axes of Chaldea as for the prehistoric bronze axes of Europe and Siberia. These observations appear to me the more worthy of interest, in that they are made on authentic objects that date in Chaldea and in Egypt from times that may properly be called historical—conditions not satisfied in the same degree by pure copper objects found in Europe. The discoveries made in Egypt and in Chaldea cast new light on problems that relate to the origin of metal industry in the history of the human race."

THE PATENT SYSTEM AS A FACTOR IN NATIONAL DEVELOPMENT.*

By WILLIAM C. DODGE.

THE question is sometimes asked: Is a patent system of benefit to a country? and not infrequently we find men and papers advocating the abolition of patents. Those who entertain such ideas generally belong to one of two classes—persons who confound modern patents with the "odious monopolies" of former times, and who think that inventions would be secured just as well without patents, and those who think that labor saving machines deprive men of employment, and are therefore injurious to the laboring classes.

This opposition has exhibited itself from the beginning down even to the present day. It is but a few years since a writer in a paper published at the capital of the United States asserted that "the invention of the steam engine and the sewing machine were among the greatest evils that ever befell mankind;" and it is a matter of history that in the same enlightened land prayers were offered in some of the churches that the wickedness of the newly invented sewing machine might be made apparent, and it makers be struck with a conviction that would induce them to stop its manufacture!

More recently an organ of a labor organization insisted that the introduction of patented machinery worked injury to skilled labor, as have also the leaders of some of these organizations, and writers in periodicals, during the past year.

It is to correct these erroneous impressions that I present the following facts.

If those who confound modern patents with the "odious monopolies" granted by the monarchs would but consider for a moment, they would see how erroneous such an idea is.

Under the old system of "monopolies," rights of which the public were already in full possession were arbitrarily taken from the public and conferred upon individuals, greatly to the injury of the public. For instance, Queen Elizabeth bestowed upon her favorites the exclusive right to sell steel, salt and other articles in the kingdom, the price of salt by the monopoly being increased from sixteen pence to fifteen shillings—over eleven hundred per cent.

On the contrary, a patent, instead of taking from the public anything which it already has, induces the inventor to spend his time, labor and money, and exercise his genius, in devising and giving to the public something new—something which it wants, and which, but for his invention, it might never have had. True, it gives him the exclusive right to make, sell, or use the invention, but only for a brief period, and that only upon the condition that he shall so illustrate and describe it that the public can make and use it at the expiration of his limited right, and thereafter have it free forever.

The difference between a modern patent and an old time monopoly is as clear and as distinct as the difference between day and night, and there is no excuse for their being confounded by any intelligent person. In fact, it was to abolish and prohibit the "odious monopolies" that the patent system was established.

In no part of the world have inventions been so extensively made and used as in the United States, and there can be no better way of determining whether the patent system has been beneficial, and whether or not it is for the public good to continue it, than to consider what it has done for that country.

To get an idea of what has been accomplished during the first century of American existence under the patent system, let us briefly compare the condition of the United States in 1790 with that of 1896.

Their territorial area has increased from 830,000

*From a copyrighted article in the Engineering Magazine, republished by permission.

square miles to 3,314,220; their population from 4,000,000 to more than 70,000,000; their 75 post offices to about 70,000; and their 1,500 miles of postal routes to nearly 500,000 miles, on which there is a travel of 409,388,425 miles—enough to encircle the globe more than 16,000 times! In 1790 they had practically no manufactures. At the close of the revolution their manufactures amounted to only \$20,000,000, the total product as late as 1830 being but \$80,000,000; while in 1890 their manufactured products amount to almost \$9,250,000,000—far more than those of Great Britain, and more than one-third of the total manufactured products of the world. At the same time their agricultural products have grown to the sum of \$4,500,000,000 per annum.

In 1790 such things as steamboats, railroads, telegraphs, and telephones were unknown, while now the United States have 181,000 miles of railroad, with a total trackage of 221,000 miles, giving employment to about 800,000 persons.

The street and suburban railways aggregate nearly 40,000 miles, of which nearly one-third are electric roads, with 30,000 motor cars.

On the 15,000 miles of Western navigable rivers and 95,000 square miles of lake surface there are 2,705 steamers, with a tonnage of 806,584 tons, while the craft on these inland waters number 10,237, with a tonnage of 4,319,734 tons. The traffic on the great lakes alone amounts to nearly 40,000,000 tons. During the eight months of navigation 60,000 vessels pass through the Detroit River, with a tonnage of over 36,000,000 tons. The tonnage of entrance and clearance of the two ports of Chicago and Buffalo exceeds that of any city in the world, except London, and very nearly equals that (London, 20,962,534; Chicago, 10,288,868; Buffalo, 9,560,590). From the single port of Escanaba, on Lake Michigan—a place so young as to be unknown abroad, and known to but few at home—there were shipped in 1892 nearly 4,000,000 tons of iron ore and 120,000,000 feet of lumber, her tonnage being more than half of that of Liverpool, which is excelled only by that of London.

The United States produce now more iron ore and manufacture more iron and steel than Great Britain, which heretofore has led the world in that line. They have 839,905 miles of telegraph wires, with 25,000 stations, independent of ocean cables, and 440,750 miles of telephone wires, with more than 500,000 instruments in use.

But, wonderful as these statistics show the growth of the country to have been, they do not tell the whole story; for it must be borne in mind that in 1790 the four millions of people were scattered mostly along the Atlantic seaboard in sparse settlements. Moreover, it must be remembered that this small number of settlers had the whole continent to subdue—forests to clear, farms to open, houses, roads, bridges, schools, and churches to build, in fact, everything to create, with the savages to contest every foot of advance—and that the western continent had neither the accumulated wealth nor the surplus labor of the old world with which to accomplish this gigantic task. But even that is not all, for, in order to get a clear idea of the conditions under which the United States began existence as a nation, one must consider also the restrictions placed upon the colonists by the mother country.

The policy of the mother country from the very first was one of suppression of all manufacturing industries. As early as 1621 an order of the king and council prohibited the shipment of tobacco or any other production of the colonies to any foreign port, except to be first landed in England, and a duty paid on it there.

This policy was continued even after American independence, and various acts, from 1781 to 1796, were passed, prohibiting under heavy penalties the shipment from Great Britain of "any machine, tool, engine, press, paper, utensil, or any part thereof, or any model or plan thereof, which was, or thereafter might be, used in the manufacture of woolen, cotton, linen, or silk manufactures," and also prohibiting the shipment or enticing away of any artificer or workman in these several branches; and in 1795 this act was made perpetual.

It was not until 1825 that the restriction upon workmen leaving the country was repealed, and that upon machinery not until 1845.

The object of all this, as stated in the preamble to the act of 1763, was "the keeping of his majesty's subjects in the colonies in a firmer dependence," "the increase of English shipping," and "the vent of English manufactures." The idea and purpose of the British government in reference to the colonies was succinctly stated by Sir Robert Peel, when he said: "It is the destiny of the United States to feed Great Britain, and the destiny of Great Britain to clothe the United States."

Of course, under such control by the mother country, the colonists could engage in nothing but farming and the production of raw material, to be shipped to England for the use of her manufacturers.

During the revolution manufactures were established to partly supply home needs, but with the close of the war a reaction set in that soon destroyed most of them. Under the confederation of the colonies, which was solely for common defense, the general government had no power to grant patents, or to regulate commerce, or to impose duties on foreign goods, those rights being exercised by each colony or State as it saw fit. Massachusetts, New York, and those most interested in commerce, imposed no duties, and the result was that, in a year or two after the close of the revolution, the country was so flooded with the cheap products of England and other countries as to break down all the manufactures that had been established during the revolution and bankrupt the merchants. So terrible was the condition of affairs that petitions were sent to Congress asking it to issue "fiat" paper money, and loan it to the people. In Pennsylvania the State government actually did this.

It was this condition of affairs which finally resulted in the constitutional convention in 1787, which conferred on Congress the powers under which the country has since grown to its present estate. Among the powers conferred on Congress by the Constitution, two of the most important, so far as national prosperity and growth are concerned, are the power to regulate commerce and impose duties on imports and the power to provide for the grant of patents. These may well be termed the right and left arms of American growth.