chemist, came to England fresh from the laboratories of Kolbe, Bunsen and Kirchhoff, and stayed to build up the famous firm of Brunner, Mond and Co. and to found the Davy Faraday Research Laboratory at the Royal Institution. Sir John Eliot (1839–1908), from St. John's College, Cambridge, went to teach mathematics in India and became the Director-General of the Indian Meteorological Service, benefiting both those ashore and afloat by his study of cyclones. August Kundt (1839–94), the successor of Helmholtz at Berlin, is remembered for his original investigations in sound and light. Josiah Willard Gibbs (1839–1903), of Yale, was Copley medallist in 1901. He was", said Sir William Huggins, "the first to apply the second law of thermodynamics to the discussion of the relation between chemical, electrical and thermal energy". His name will always be associated with the Phase Rule.

In his own particular sphere, none occupied a more prominent place than the American engineer and educationist Robert Henry Thurston (1839–1903). At the Stevens Institute, Hoboken, Thurston organized the first mechanical engineering laboratory in the United States, while at Sibley College, Cornell University, whither he went in 1885, he saw the number of engineering students under him grow from a total of sixty to 900. He was a founder and the first president of the American Society of Mechanical Engineers.

In conclusion, attention may be directed to one or two of the outstanding scientific books published in the year 1839, and one or two events which excited considerable interest, or proved of lasting importance, to the world of science. Among the books were the first volume of Faraday's "Experimental Researches in Electricity" and Darwin's "Journal and Remarks, 1832–36", which appeared as the third volume of Fitz Roy's

"Voyages of the Adventure and Beagle". Of Darwin's work the *Quarterly Review* said, "We find ample materials for deep thinking; we have the vivid description that fills the mind's eye with brighter pictures than painter can present, and the charm arising from the freshness of heart which is thrown over these virgin pages of a strong intellectual man, and an acute and deep observer". Another notable book was Murchison's "The Silurian System", which Sir Archibald Geikie called a "splendid monograph with which it was now possible to carry the vision across a vast series of ages, of which hitherto no definite knowledge existed", and yet another, W. H. Miller's "Treatise on Crystallography".

The year 1839 was also marked by the announcement by the naturalists Theodor Schwann (1810–82) and Matthias Jakob Schleiden (1804–81) that all the higher animals and plants are made up of cells; by the invention by Sir W. R. Grove of his battery experiments with which Schönbein was led to his observations on ozone; by the discovery by Charles Goodyear of his process of the vulcanization of rubber, and by the first trials of the historic pioneer screw-driven vessel *Archimedes*. But nothing excited more enthusiasm in scientific circles than the publication of the account of Daguerre's method of obtaining pictures on metal plates. On January 7, 1839, Arago communicated Daguerre's invention to the Paris Academy of Sciences, and in the summer the French Government purchased the invention, making the inventor an officer of the Legion of Honour and awarding him a pension of 6,000 francs. A fortnight after Arago lectured at the Academy of Sciences, Faraday at the Royal Institution described Fox Talbot's invention of "photogenic drawing". These were both notable steps in the early progress of photography.

Potato Problems*

By Dr. S. Linné, Ethnographical Museum of Sweden, Stockholm

THE native peoples of America were clever botanists, and the culture inherited from the Indians has supplied humanity with numerous cultivated plants of inestimable value; for example, the potato, maize, cacao, tobacco, tomato, etc. The potato is certainly the most important,

along with maize. In four Masters Lectures before the Royal Horticultural Society, Dr. Salaman has presented the latest discoveries and the results of his own investigations and of those of others concerning the potato in ancient and present times in America, and its introduction into Europe.

It is certainly not surprising that this important cultivated plant, and the question as to its origin, have attracted the attention of botanists, but Dr. Salaman is the first scientist to have studied the potato problem not only from an archaeological,

*The Potato in its Early Home and its Introduction into Europe, Masters Lectures, 1936, by Redcliffe N. Salaman (*Journal of the Royal Horticultural Society*, Vol. 62. Pp. 53+46 figs. London, 1937.) A brief summary in which certain points of view have been revised has since been given in a discourse entitled "The Origin of the Potato and its Influence on Man's Early Settlement in South America," published in the *Proceedings of the Royal Institution of Great Britain* (30, No. 141, pp. 26+9 figs., 1938).

but also from a 'psychological', point of view. By way of introduction he points out that Russian savants conducted several expeditions during 1926-32 and greatly increased our botanical knowledge of the potato, establishing, among other things, that the majority of the thirteen tuber-bearing species of *Solanum* have, from earliest times, been cultivated by the Indians of South America. They have further demonstrated that the potato, numerous wild forms of which exist from Colorado to Chile, but which was only cultivated in South America in pre-Columbian times, developed in two distinct areas. They are the Peruvian and Bolivian plateaux (*Solanum andigenum*) and the Island of Chiloe and neighbouring parts of the Chilean coast (*Solanum tuberosum*). The common domestic potato of Europe, and *S. tuberosum*, are identical, and according to the Russian investigators it then follows that the potato introduced into Europe towards the end of the sixteenth century came from Chile.

Dr. Salaman, however, holds an entirely different opinion, and the evidence presented by him appears to be irrefutable. First of all, the parts of the Chilean coast referred to had not yet been conquered by the Spaniards, for the natives made very stubborn resistance, and it must thus have been rather a difficult task to obtain potatoes there. Even though it may have been possible, the crop would then have been harvested at a very unsuitable time for the potatoes to be set in Europe. Chile is in the southern hemisphere and the potato is harvested in April. Considering the communications at that time, the potatoes would be of no use for planting on their arrival in Europe; and they also would have been stored for some time in the tropics. In the Peruvian and Bolivian highlands with their varying nature, however, it would have been possible to select a more suitable time. The difficulties of transportation would have been considerably simplified if seed had been taken instead of tubers, but this must be considered excluded. The Indians, who taught the Spaniards how to cultivate potatoes, always planted tubers, and still do, and it was European botanists who later became interested in the seeds.

Also, from a botanical point of view, difference between *S. andigenum* and *S. tuberosum* is so small that, according to Dr. Salaman's analyses, it cannot be definitely determined whether the European potato had its origin in one or the other. It is known from the time that the potato was first cultivated in Europe that it set seed freely, which is a characteristic of *S. andigenum*. Seedlings were raised, and new varieties were soon produced. The Indians cultivate about one hundred varieties, and everything indicates that they had a very rich

assortment also in early times. At village fairs in southern Peru, the natives have been seen to offer for sale more than sixty different varieties of potatoes.

As regards the introduction of the potato into Europe, it has hitherto been considered that 1588 was the earliest fixed date. The potato was then cultivated in Italy, having come from Spain. However, thanks to various data in the literature hitherto overlooked, Salaman has succeeded in demonstrating that it was cultivated in the neighbourhood of Seville in 1572, and he considers it likely that it was first introduced at least ten years earlier.

A little later, but quite independent of Spain, the potato made its second entry into Europe, this time into England. However, it did not come from Virginia, as is often stated; for it is not native there and was not introduced there until more than a hundred years later. Salaman is of the opinion that Sir Walter Raleigh should have the credit of being the first to introduce and plant potatoes in England, and that this was in 1586. There is as yet no absolutely conclusive proof of this very momentous event, but apparently the introduction occurred on two occasions, quite independently, in Spain and in England, the potato thence finding its way to the rest of Europe. In both cases, the potato derived its origin from Peru, Bolivia, Ecuador, or Columbia, but scarcely from Chile.

We can obtain a knowledge of the early history of the potato and of its use in America from the chroniclers of the conquest and from the pottery found in pre-Spanish graves on the Peruvian coast. Seeing that the art of writing was unknown in South America, it is the archaeological investigations alone that can throw light upon the history of the country prior to the arrival of the Spaniards. The pottery thus plays a prominent part; for the wonderfully shaped ware of the Peruvian people portrays human beings and animals, weapons and tools, scenes of everyday life, battles and religious ceremonies. The pottery from Chimu, on the northern part of the Peruvian coast, is especially outstanding in virtue of its ever-varying choice of motifs, vivid naturalism combined with a keen eye for artistic effects and unsurpassed technical skill. Five consecutive periods can be distinguished and be dated approximately, from the beginning of our era up to the arrival of the Spaniards and the downfall of Inca in 1533. The Chimu ware is thus also the main source of our knowledge of the use of the potato in prehistoric times and of the religious conceptions attached to it.

The potato was cultivated in the highland valleys and plateaux of the Andes, but for climatic reasons it was not cultivated on the slopes towards

the coast or on the actual coast, that is, in the river valleys, which, separated from each other by stretches of deserts, were the only districts suitable for agriculture, especially for the cultivation of maize. Several types must have been raised at a very early date: *inter alia*, a hybrid form which was rather frost-hardy. It is very probable that, in its native country, the potato has been cultivated for three millennia.

It is strange that only in the pottery of the coastline do we find reproductions of the potato. This is due to the fact that the highland ware on

years ago, and was undoubtedly the same two thousand years earlier. Probably chuno is one of the first preserved foodstuffs that ever existed. Not until potatoes were cultivated and this method of preservation introduced could the Peruvian and Bolivian highlands feed a more numerous and permanent population. It is thus impossible to over-rate the importance not only of the potato but also of chuño for man's conquest of these territories.

One of the theories upon which Salaman founds considerable parts of his historical comments is that the Peruvian coastal population crossed the mountains from the South American primitive forests. This is connected with his opinions as to how man originally took possession of the continent, and here the presence of chuño in the graves on the Peruvian coast plays a prominent part. Salaman considers that the immigrants were unable to penetrate the Isthmus of Panama on account of its rain-forests and its generally inhospitable nature. In the event of their crossing from Central America to South America in canoes, chuño, which did not exist in Central America, would not have been found in the graves on the coast. Certainly the woods in the Isthmus of Panama are difficult to penetrate, and I know from my own experience that this is true with reference to Europeans but not as regards the natives. Nor must the fact be forgotten that the whole Isthmus has from ancient times been inhabited by native tribes, and that even they have produced cultures of a high level. Furthermore, the Peruvian coast was undoubtedly populated long before the potato was common food and before the culture flourished from which Salaman has obtained his archaeological proof. This is demonstrated, *inter alia*, by the remains found after the primitive fisher population at Arica and other places.

That "the original settlers reached South America via the great river systems of the Orinoco and the Amazon" is a hypothesis that remains to be proved, and can be accepted only when further reasons have been produced. According to Salaman, these early immigrants found little attraction in the forest and river districts and made their way up the high Andes. The reason for their doing so he considers can be expressed "in the one word fear", which would appear to be rather too simple an explanation, especially as the forests had quite a considerable Indian population which have produced rather highly developed cultures, suited to the conditions, and satisfactory for their existence. We are unable to determine what occurred in a dim and distant past when South America was gradually becoming populated by immigrants from the north. Weaker peoples were elbowed out by stronger ones; migrations and

YELLOW ANTHROPOMORPHIC POT FROM CHIMBOTE. FIGURE COMPOSED OF POTATO TUBERS WITH PRONOUNCED 'EYES'. NOTE THE EXCISED NOSE AND RESECTED UPPER LIP. Reproduced by permission of the Council from *J. Roy. Hort. Soc.*, 62 (1937).

the whole has no reproductions of either human beings, animals, or other objects. Thanks to the dry climate—there is practically no rain—and the high nitrate content of the soil, everything that was deposited in the graves on the coast has been preserved. Even in the graves dating from the oldest Chimu culture has there been discovered pottery in the shape of potatoes and chuno, that is, preserved potatoes. The manner of producing chuño, freezing, treading on the tubers spread on the ground, with the view of squeezing the water out of them, and drying, is to this day the same as that described by the Spaniards four hundred

displacements were continually occurring due to various causes. Undoubtedly, the jungle and rain-forests were not populated very extensively until comparatively late; primitive culture as well as real civilization belonging to the dry territories.

The above-mentioned Chimu vessels with potato motifs have been arranged by Dr. Salaman in certain groups with special reference to the motifs, these groups also being chronologically separated from each other. Those dating from the oldest period are mainly anthropomorphic, that is, having human shapes, but they display tuber-like parts in which the 'eyes' of the potato are represented.

like form, are increasingly suppressed. During the Inca period, finally, there are seen only faint traces of the eyes, the potato-shape, too, having almost vanished.

Dr. Salaman is of the opinion that the mutilation of the nose and lips is a kind of ritual sacrifice. For reasons unknown, he assumes that "for the sake of the potato" the coastal population originally sacrificed human beings, but that later they contented themselves with the mutilation, which was finally replaced by merely removing the upper lip. The Peruvian potato tuber is often blood-red, with very deep eyes surrounded by a brow.

PROTO-CHIMU ANTHROPOMORPHIC POT FROM TRUJILLO. CREAM AND RED. FRONT AND BACK VIEW SHOWING EXTREME MUTILATION OF NOSE AND MOUTH. BACK OF HEAD ORNAMENTED WITH POTATO EYES. Reproduced by the permission of the Council from *J. Roy. Hort. Soc.*, 62 (1937).

The majority portray human beings with mutilated faces; nose and lips have been cut off. The oldest vessels are most severely mutilated; in the later ones the mutilation is often merely indicated, and finally it was limited to the removal of the upper lip.

Later, there appear no mutilations, though the pots maintain their anthropomorphic type, but with tuber-like projections and the stigmata of the potato eye. Gradually the human shape attracts less and less interest and the potato-shape becomes more and more predominant. During the Late Chimu period the realism at last almost disappears: thus also the mutilations, and the tuber-

According to Dr. Salaman's hypothesis, the natives looked upon the eyes as a mouth from which the new buds stood out like teeth. As the potato-spirit had to be given new strength to replace what had been consumed, this would be accomplished by a sacrifice which in some manner was connected with the potato's most important part. Experience had taught the native that the bigger the mouth and the more prominent the teeth, the richer was the crop. By removing the lips and denuding the teeth of the sacrifice, the resemblance to the potato mouth was created, and the potato-spirit could not be mistaken as to what was expected from him.

I regret to say that I can scarcely follow, and still less agree with, these views. We do not know the part played by the potato in the household of the coastal population, nor do we know whether or not chuño was present in the graves of pilgrims from the mountains. It certainly seems very improbable that the coastal population should have made sacrifices to the potato-spirit operating in the highland districts, with which they had nothing to do but to purchase his products. There are, moreover, numerous vessels portraying mutilated faces which have nothing whatever to do with the potato, and which medical specialists have presumed to represent morbid changes, *inter alia*, syphilis. It would not appear very remarkable that, in their art, which need not always be of a magic character, the natives found reason to express a resemblance between a face deformed by a disease and the potato, which resemblance certainly may be striking.

As a support for his theory, Dr. Salaman has collected a large number of instances of sacrifices and ceremonies of various kinds connected with the setting and harvesting of potatoes from the discovery of South America to the present day. These rites subsist as an echo of ancient times, but they do not prove that the coastal people sacrificed human beings to the potato-spirit, or that the mutilation portrayed by the pots is an expression of a fertility rite.

Dr. Salaman's studies overflow with interesting, personal working theories, which, however, in many cases cannot very well be made to agree with our knowledge of the customs of the South American natives. It is indeed very satisfactory, though in many cases one may feel sceptical of the results, that an important problem is discussed so extensively without considering ordinary archaeological and ethnological methods and with fresh points of view.

News and Views

Sir Richard Gregory, Bart., F.R.S.

A PERIOD of forty-five years is but as a day in the life of a State; it is a large fraction of the life of one man. Yet, as will be seen from the first article in this issue, it represents the period during which Sir Richard Gregory has been associated with NATURE; and since 1919 he has governed the policy of the journal, which has become intimately associated with his name. His retirement will come as a shock to many readers, and it will be a loss to all that his great qualities of leadership, matured by long association with the journal, will no longer be directly available to us. In his message to readers of NATURE, in the present issue, he has stated in his own inimitable fashion the policy that has ever guided and encouraged his labours for science and for humanity, and there is no need to elaborate them here. They may be summed up in two phrases: a clear recognition of the importance of the reactions of advances in science on the well-being of the community, and intense faithfulness to the ideals of the freedom of learning and its independence of national boundaries, of caste and of creed.

NATURE, probably more than any other periodical of its age and status—it will shortly celebrate the seventieth anniversary of its birthday—has preserved a consistency of outlook which has widened rather than changed fundamentally with the changing years. This is in great measure due to the wisdom and foresight of the two editors, Sir Norman Lockyer and Sir Richard Gregory, who have for so long a period guided its fortunes. Sir Richard, in particular, clearly perceived the increasingly large share which science was bound to take in moulding the social life

of the community, and the corresponding increase in the responsibilities of the man of science towards that community whose fate may—nay, will—be determined by the use, or misuse, of the powers that he puts into its hands. These views have, of late years, been elaborated with increasing force in these columns, and the world at large is deeply indebted to Sir Richard Gregory for the vigour and clarity with which he has expounded them. His retirement from active participation in NATURE will, we trust, release him for yet further public work for the advancement of civilization and progressive science.

Sir James Jeans, O.M., F.R.S.

THE appointment by His Majesty the King of Sir James Jeans to the Order of Merit is a well-deserved reward for outstanding work in mathematical physics and astronomy. Jeans's earliest investigations were concerned with the dynamical theory of gases; by the use of generalized co-ordinates, he gave a rigid proof of Maxwell's law of distribution of molecular velocities, and of the theorem of equipartition of energy. He also improved the theory of viscosity and made important contributions to the theory of radiation and of quanta. When a pupil of Sir George Darwin, he had become interested in the difficult problem of the stability of the pear-shaped form of rotating, incompressible, gravitating fluid. Darwin, Poincaré and Liapounoff had discussed this with discordant results. By a masterly piece of analysis, carried to a third-order approximation, Jeans was able to show that this form was unstable. He then turned to the more difficult problem, which is of greater importance for cosmogony, of a rotating mass of compressible fluid, and showed that for a