	α 0·000
Naphthalin	3200
Chloral hydrate	1482
Urea	1579
Iodoform	2930
Iodine	2510
Sulphur	1152
Mercury	0887
Sodium	1865
Graphite (Cumberland)	0733

Sodium, extending down to low temperatures, has a coefficient about the same as that of mercury at the ordinary temperature. The coefficient for sulphur is about half of that between 0° and 100°, being 0·0002237, and that of iodine is not far removed from the value 0·000285 given for the solid at ordinary temperatures. The rate of expansion of liquid iodine is about three times this value. Paraffin ought to have a value of 0·0004633 from Fizeau, but Rodwell's coefficient between 0° and 38° is 0·00035. The value found for naphthalin is about half that of the liquid near its melting point, viz. 0·000785. If the liquid coefficient be taken at a corresponding temperature to that of the liquid carbonic acid when comparing it with the solid, then its value is 0·001213, or the coefficient would be now in the ratio of 4 to 1. The graphite calculated from Fizeau should be 0·0000929, which is greater than my value; but the samples were different. My two specimens of chloride of ammonium gave nearly the same value, and the result is in agreement with that found by Playfair and Joule, viz. 0·000191. If a Fizeau coefficient for this salt is calculated, the value is 0·0000761, which in this case is far too small. The coefficient found for oxalic acid is again only a little smaller than that given by Playfair and Joule, viz. 0·0002748. As regards the hydrated salts, phosphate of soda, hyposulphate of soda and chloride of calcium, having the respective values 0·0001384, 0·0001516 and 0·0006887, as found by Kopp, the low temperature coefficients are much smaller in each case. With the exception of carbonate of soda and chrome alum, all the other hydrated salts have a coefficient of expansion not differing greatly from that of ice at low temperatures. Generally, the densities of the compressed blocks of different bodies agreed well with the results of other observers, but my potash alum had only a density of 1·614, whereas Playfair and Joule give 1·731. It will be noted that iodoform is a highly expansive body like iodine, and that oxalate of methyl has nearly as great a coefficient as paraffin, which is one of the most expansive solids. The correcting factor was used for paraffin, naphthalin, chloral hydrate, iodoform and sodium.

It will be possible by cooling the moulds with liquid air during the process of hydraulic compression to produce cylindrical blocks of solid bodies of lower melting-points than any given in this investigation, such as alcohol, ether, nitrous oxide, ammonia, chlorine, &c., and to ascertain their coefficients of expansion in the solid state between the individual melting points and the boiling point of liquid air.

This method, which works well with liquid oxygen or air, fails when applied to liquid hydrogen, as the density of the liquid is too small (apart from other difficulties) to give accurate values of the weights of fluid displaced. For temperatures about 20° absolute, recourse must be had to measurements of the coefficient of linear expansion, and such observations could only be applied with ease to metallic bodies and alloys.

THE RISE OF THE EXPERIMENTAL SCIENCES IN OXFORD.[1]

IN the Middle Ages, the scholars swept in flocks, like migrating birds, from school to school. What we now call a University was then no particular spot on the earth; but, like the ark in the wilderness, moved whithersoever a great teacher, such as Fulbert, the Anselms, Abélard, Peter Lombard, unfurled his standard. This mobility was, indeed, a guarantee of the freedom and the power of learning.

The "Civitas Philosophorum," as Saint Thomas called Paris, was engaged in 1209 in burning all the works imputed to Aristotle. This attack "on the Lehrfreiheit" of Paris, when the culture of the first renascence was streaming into Europe from the Arabian sources, drove its scholars abroad, and flights of them came to the comparatively unknown schools of Oxford and Cambridge. Oxford, already a centre of public affairs, sprang more suddenly than Cambridge into fame—on the scholastic side under the influence of the Friars Minors.

The Grey Friars, then breathing the humane spirit of their founder, stood for the people and for freedom, while the Friars Preachers were on the side of authority. Robert Grosseteste, who made Oxford as Abélard made Paris and Fulbert made Chartres, and his pupils, Adam Marsh and Roger Bacon, became Greek scholars of no inconsiderable attainment at a time when the potable gold of Greek tradition had virtually died out in the west, and with it the inspiration of natural knowledge. Adam Marsh, himself a Minor, was a statesman, a close friend of Simon of Montfort, and a champion of freedom of learning. Balliol was founded under Franciscan influences, and under this first temper in the next century, then in the teeth of the Minorites, Oxford was keenly Lollard; and with the suppression of Lollardism all intellectual life deserted her courts. Nevertheless, Oxford during the Middle Ages was a child of Paris rather than of Italy, whence Cambridge drew much of her nourishment, and was the picturesque stronghold of hierarchical traditions. Albert of Cologne, himself a Franciscan, vindicated against Paris the science of the Arab schools, and dignified the study of natural knowledge and experiment.

Pioneers of science may be divided into two kinds, into a group who, like Galileo, Boyle and Harvey, were themselves discoverers, and a second group, like Roger Bacon, Telesio, Patrizzi, Campanella, Francis Bacon, Ramus and Marsiglio, who did service rather as protestants and reformers of method. Whether Roger Bacon were more of a chemist than Albert of Cologne, or whether either got beyond the chemistry of Geber, whether Bacon advanced in optics, his special study, beyond Al Hazen, it is less important to ascertain than to declare that Bacon's title to fame is that he revived true methods of investigation. Many ancients had made experiments; Aristotle made many, Pliny made many; Bacon first declared that it was not experiment, but the experimental method, which was to regenerate science. We must not suppose that Roger Bacon was alone, as one crying in the desert; with the Arab illumination, natural science was in the air. Many voices, such as that of Peter of Méricourt, to whom Bacon regarded himself as indebted, preached experiment and contemned authority in natural research. The works of Nemorarius of Borgentreich, who first advanced from the statics of Greek and Arab to dynamics, were known to Bacon. The parabolic mirror and its focus were known to Al Hazen. Grosseteste had larger views than either Hales or Albert, and was no inconsiderable geometer. He wrote a treatise, "de Iride et de Cometis," and was a keen inquirer into the new sources of knowledge, including the "Res Physica," or medicine. Thomas Bungay, the eighth Provincial of the Friars Minors, was engaged with Bacon at Oxford in natural investigation, and, like other such inquirers, was regarded as a wizard. In Italy natural science continued, even in some abundance of life; but in Paris on the Isis, as in Paris on the Seine, its rudiments were soon buried under the Aristotelian and Galenical cenotaph by that busy gravedigger, Duns the Northumbrian, and were not dug up again until the day of Abbot Maurolycus and Vesalius nearly three centuries later. Thus one of the most piercing intellects and one of the most progressive societies our land has produced founded no school.

The great experimenters of the thirteenth as well as of the sixteenth and seventeenth centuries could hardly obtain skilled craftsmen for the construction of apparatus. Many observers, however, were themselves ingenious constructors—such as Archimedes, Hero, Leonardo, Brahé, Gilbert, Galileo, Huyghens, Hooke, Papin and, in our own time, Faraday and Ludwig. Roger Bacon, in his expenditure of money and labour upon machines, preceded Boyle and Hooke. We are not to suppose that Roger's machines were clumsy and rudimentary. The Alexandrian and Byzantine Greeks, and after them the Arabs, had constructed apparatus of surprising elaboration and ingenuity, and Bacon's machines would be well abreast of their time. In the sixteenth century, again, the reappearance of Greek preceded a new birth of natural science; although, unless at Wittemberg or Basel, freedom of speech was more closely stifled in Europe than in the time of Abélard, for Calvin himself bowed before Aristotle. William Solling, Linacre, Grocyn and Colet were therefore forerunners of the brilliant scientific revival of which, in the seventeenth century, the establishment

[1] Abstract of the Boyle Lecture delivered at Oxford on May 13 by Prof. T. Clifford Allbutt, F.R.S.

of the great scientific societies, the Lincei, the Paris Academy and the Royal Society, were the organs and the witnesses. We find in the life of Bruno a vivid narrative of the Oxford of the sixteenth century. Bruno visited Oxford in June, 1583, with the French Ambassador Castelnau, the translator of Ramus. Of the disputations in the schools, of their pompous frivolity, he gives a very amusing description. The earth, said Aristotle, Paris and Oxford, is motionless; the universe is finite and moves. Bruno, in the name of Philolaus and Copernicus, protested that the earth revolves and that the universe is infinite; and the dispute grew venomous. Bruno asked and was granted permission to teach in Oxford; but as *dormitantium animorum excubitor* he seems to have been even less successful in combating the physics of Aristotle than was Ramus in respect of his dialectic and Luther of his ethics.

Orthodoxy is the defensive weapon of society rather than of religion; when the needs of the two came into conflict it was religion which went to the wall. Happily "certain extravagant chemists," of whom more anon—and the Ramists, Paracelsians and Italian philosophers, were shrewdly assisted by new factors in the worlds of polite society and letters. As Petrarch and Boccaccio disarmed the academic coxcombs of Padua, now again in France the sceptical bonhomie of Montaigne, the revolutionary philosophy of Charron, the merciless raillery of the Mariage Forcé and the polished satire of Boileau did more to penetrate the armour of the Church than the hardier rebels to bruise it. By them the shabby Aristolelian effigy, battered by the weapons of Roger Bacon, of Galileo, of Harvey, of Telesio and Descartes, and bedaubed with the missiles of Patrizzi, of Ramus and of Verulam, was finally broken up and demolished. In the middle of the seventeenth century at Wadham, Warden Wilkins gathered about him a constellation of scientific men such as has perhaps never gathered together in any other time or place. Robert Boyle, Christopher Wren, John Locke, Robert Hooke, and, but little latter, John Mayow, all of them men of genius, were at the head of a society which was the foundation of the Royal Society, and among its lesser lights contained names no less than those of Seth Ward, John Wallis, Thomas Willis, Roger Lower and William Petty. The lecture concluded with a study of Boyle, not only as a scientific discoverer, but also as a philosopher and a reformer of method of far greater insight than Dr. Whewell admits, and, moreover, a man of charming temperament and an accomplished man of letters.

ANTHROPOLOGICAL RESEARCHES IN INDIA.[1]

LIEUT.-COLONEL DR. WADDELL has been constrained to make a careful study of the savage tribes that live in the mountainous valleys of the upper waters of the Brahmaputra, as he realised that the unique mass of ethnological material which is stored in these mountain recesses is being allowed to disappear unrecorded. It is said to be no uncommon sight to see a Naga, who only two or three years ago was a naked head-hunting savage of the most pronounced type, now clad in a tweed coat and carrying a Manchester umbrella, taking his ticket at a railway station. Dr. Waddell states that one of the oldest European residents of Assam, Mr. S. E. Peal, urged at every opportunity in the public Press and in communications to the Asiatic Societies, the Royal Geographical Society and the Anthropological Institute of London, in the strongest terms possible, the necessity for action without further delay. In despair at the apathy displayed in the matter, he willed away at his death, a few months ago, to a museum in New Zealand all his collections of miscellaneous notes and specimens of the vanishing ornaments and primitive costumes of these wild tribes. Colonel Woodthorpe has emphasised the loss to ethnology if the many interesting tribes are not carefully studied soon. Mr. Wharry, adviser on Chinese affairs to the Government at Burma, says:—"The chance of studying these peoples to full advantage is fast slipping away."

The observations published by Dr. Waddell relate to about 600 individuals belonging to more than thirty tribes or groups. After briefly describing the influence of topography on the ethnology of the district and the racial elements, he gives a short account of a large number of tribes in alphabetical order. This section contains a great deal of very interesting matter which is of value alike to the ethnologist and to the student of comparative customs. Then follows the detailed anthropometric data and seventeen plates of portraits and groups. As the tables of indices and the "comparison of the results and the bearing of these on the question of the affinities of the tribes" are not given in this part, we assume they will follow in the next number of the journal, when it is to be hoped the equally bulky data for the tribes of Tibet and Burma, which the author has amassed, will be published for the benefit of his colleagues at home.

The laborious work accomplished single-handed and mainly at his own expense by Colonel Waddell deserves our warmest thanks, and we hope he will feel that anthropologists thoroughly appreciate his self-denying labours. It is quite beyond the power of the few students at home to help in supporting, save by encouragement, such workers as Colonel Waddell. To our shame be it spoken, there is no organisation by which the wealth of those who have abundance can be directed towards the pressing needs of field-work among primitive peoples, such as is so pathetically advocated by the author of this paper, and our Government also is apathetic to the study of native races; one can only hope that this negligence is due to ignorance.

Since Colonel Waddell wrote his paper, the Government of India has undertaken to conduct an Ethnographic Survey of India in connection with the census of 1901. This action was due to the initiative of the British Association at the Dover meeting in 1899; particulars of the proposed scheme of work will be found in *Man*, September 1901, p. 137. As Mr. Risley, the author of "The Tribes and Castes of Bengal," has been appointed Director of Ethnography for India, we may feel sure that the Survey will be wisely planned, and we sincerely hope that sufficiently skilled workers are employed and that the usefulness of the Survey will not be impeded through lack of funds. While we are thankful for this official recognition of the claims of anthropology, it is still necessary to repeat, what has so often been urged in the pages of NATURE, that there is an enormous mass of ethnological material in our Empire beyond the seas which is yearly decreasing at an alarming rate, or is rapidly becoming so modified as to lose its original value. The loss of this vanishing anthropological information is supinely permitted by our Government. What a contrast there is between the British Government and that of the United States is known only too well by those acquainted with the annual reports of the Bureau of Ethnology.

Mr. T. H. Holland, of the Geological Survey of India, has published a very valuable study on two well-contrasted human types found in a small district of southern India. The presentation of the data, their discussion, the comparative tables, diagrams and plates, render this a model paper.

In the little province of Coorg, which embraces a semi-isolated portion of the western Ghats, there is an interesting instance of the way in which a mountainous and jungle-covered country has been turned to totally different purposes by two distinct races. The agricultural Yeruva early retreated into the little mountain province before the aggressive invaders. At a later period the splendid Kodagas (Coorgs) found in the jungles of Coorg the means of satisfying their hunting propensities, whilst the narrow passes suited their highly developed instincts for predatory raids into the country of their wealthier but less warlike neighbours. The sporting and fighting proclivities of the Coorgs reveal themselves even in their festive and religious ceremonies. From his very birth, when a miniature bow and arrow made from the castor oil plant is placed in the hands of the baby boy, the Coorg male is, or was, regarded as a huntsman and a warrior whose pride was in his size and strength; hence this is the finest race in the south of India.

A comparison of the physical characters of these two tribes proves that the Coorg is on an average 3·9 inches taller than the Yeruva, and with a relatively shorter span he has a larger and broader head, a more perfect approach to orthognathism, his nose is longer and narrower. There is a marked contrast between the fair (light brown), straight-haired Coorg and the very dark-skinned Yeruva, whose hair is distinctly wavy. The features of the latter are generally of the stamp which we should characterise as distinctly low, the broad nose being accompanied by thick, slightly everted lips.

[1] "The Tribes of the Brahmaputra Valley: a Contribution on their Physical Types and Affinities." By L. A. Waddell, M.B., LL.D., Lieut.-Colonel, Indian Medical Service. (*Journal* of the Asiatic Society of Bengal, vol. lxix., part iii. 1900 (1901) pp. 1–127, pls. ii–xviii.)

"The Coorgs and Yeruvas, an Ethnological Contrast." By T. H. Holland, A.R.C.S., F.G.S., Geological Survey of India. (*Ibid*, vol. lxx. part iii. 1901, pp. 59–98, pls. i–v.).