improbable that any change took place in its length between the time that it left India and its return from Sèvres, so that the value of bar A, viz. 3047·996 mm. at 62° F. in terms of the international metre, is thoroughly trustworthy. Pendulum work was carried on in the western tracts of the Sátpurá hills and the Vindhyan plateau as an investigation of the variation of gravity in the northern portion of peninsular India, and at seven stations, situated at from 750 feet to 2100 feet above sea-level, excesses of gravity were found. At twenty-eight stations above 750 feet hitherto observed gravity has never been in excess, so that dissimilar conditions in peninsular and extra-peninsular regions seems to be indicated. Subsequent seasons' work is being extended over Rajputana and the Sátpurá hills to the Gangetic plain. Tidal records from nine stations, Moulmein being one which was re-established, and nearly 1100 miles of double levelling, occupied a portion of the staff, while the Magnetic Survey working in Burma completed the preliminary survey with a total of 1255 stations.

Some specially disturbed areas were surveyed in detail, and this work is being continued. Heavy prolonged rain at Dehra Dun eventually forced its way into the magnetograph room, and, rising within an inch of the top of the driving-clock pillar, necessitated the removal of the instruments on August 15, which were replaced a month later. The Topographical and Forest Surveys also completed the survey of a large area of country. In cartographic work, the results of the reorganisation of the drawing, engraving, and printing branches which was carried out since 1906 are now to be seen, and the publication of standard map-sheets has kept pace with the survey and drawing, besides there being a considerable increase in outturn. A specimen sheet of the 1 : 1,000,000 map, the strategical map of India, is given, containing the region round Bombay; roads, railways, and boundaries are strongly brought out, but the relief is shown by shading, which renders main features prominent, and by comparatively few inscribed altitudes.

(2) The Bulletins of the United States Geological Survey, which deal with higher surveying, furnish the final results of work done in the field after all corrections have been applied. The numbers stamped on the bench marks in the field represent the elevations to the nearest foot above mean sea-level as determined by unadjusted levels in the field, and those who require a higher accuracy than 2 feet must consult these bulletins or apply to the offices of the Survey. The levelling is classified as precise or primary according to the accuracy of method and precision of the instruments employed, and lines are run both forward and backward in the former case, but in one direction only in the latter. The allowable limits of error in feet are respectively $0{\cdot}017\sqrt{D}$ and $0{\cdot}05\sqrt{D}$, where D is the distance in miles. In the bulletins the position of each bench mark is described and its altitude given to 0·001 foot for both classes of work.

The results of triangulation and primary traverse are likewise given in periodical bulletins, which not only give the description of each station, its mark and reference mark, and geographical position, but also the azimuth, back azimuth, and the logarithm of the distance from it in metres of all points observed from it. An interesting map of the United States is included showing the astronomic location and primary control up to January 1, 1909. While much has been accomplished, large areas remain along the 101st meridian, in the Southern States, and many other parts to be completed.

THE STANDARDISATION OF COLOURS.

Under the title of "International Rules for the Specification of Colours," Mr. Hans-Jacob Möller has reprinted an essay by him from the Journal of the Danish Apothecaries' Association (*Archiv for Pharmaci og Chemi*, November 14, 1910) showing the importance of having an international scheme of colours so as to enable reference to be made to a definite tint on a definite scale, and recommending as the most useful and most practical scheme of the kind that drawn up by Klincksieck and Valette, a scheme based upon the original system drawn up by Chevreul. There can be no doubt that such a colour scheme, recognised throughout the scientific world, would be of great practical value. For example, to take a very obvious instance, a large number of chemical reactions in connection with organic substances, such as dye-stuffs, depend upon colour changes, and if it was possible to describe these colour changes in accurate language, it would be of great practical value to the chemist.

When we come to the departments of pigments and of dye-stuffs, it is obvious that there, too, a definite recognised colour scheme would be of great practical value. It would, however, probably be better, if once a colour scheme was decided upon, that it should be reproduced in some permanent material such as coloured glass, so as to give a definite standard for reference at any future time, as a colour scheme which is merely lithographically printed may alter owing to fading of the colours, and if an attempt is made to repeat it, it is seldom that pigments can be twice reproduced with exactly the same tint.

On the other hand, an attempt to refer to definite lines on the spectrum is difficult in practice, as the use of the spectrum in this way for the matching of colours is not very easy, and it is not a satisfactory method. Mr. Möller does not refer to Lovibond's work on this subject and his scheme of coloured glasses. The present writer has found the Lovibond tintometer most useful and capable of very accurate matching, though the Lovibond standards are purely arbitrary. An arbitrary scheme seems the only possible one, and therefore, as Lovibond has devoted so much ingenious labour to the making and matching of his coloured glasses, there is a great deal to be said for defining tints by means of his tintometer, such a tintometer being kept as a standard of reference. Whatever may be determined, however, as the best practical solution of this question, it is certainly time that something of the nature of an international colour scheme be adopted, so that there should be no difficulty in referring to a definite scale and number in describing any colour.

A. P. Laurie.

DIET AND DEVELOPMENT.[1]

The main impression left by a perusal of this exhaustive report upon the diets of labour convicts in Bengal jails, referred to below, is that the Indian Government has been well served in this matter, and has now in its possession advice derived so judiciously from soundly organised and ably conducted investigations as to justify what, on weaker evidence, might have seemed a parsimonious procedure, namely, some limitation of the too ample dietaries of these prisoners. The author may be said to have proved that their vegetarian diet, such as is the common food of the native population, has been provided in quantity so large as to escape digestion. No one will find reason to doubt his statement that this undigested material gives occasion to various forms of distressing trouble whilst in disordered transit through the alimentary canal of its consumers; not that this point is new, but that the condition has been very definitely shown as existing in this special and important case.

It would seem that, prior to this investigation, the diets had been arranged so as apparently to display the same "protein value" as a European diet. In the effort of imitating the heavy labour diet of English prisons with combinations of the native food-stuffs, meals of extraordinary bulk have been provided. Whereas, when added in small quantity to the varied constituents of a European meal, similar food-stuffs may yield so much as 80 per cent. of their contained protein for absorption into the tissues of the body, the author has shown that often no more than 50 per cent. is absorbed from them when found as the main constituents of a bulky meal, and this notwithstanding the fact that bulky meals are characteristic of the district, if to a somewhat smaller degree than within its jails. He has also proved that a certain ascertained diminution in this bulk, accompanied by an apparent diminution in the protein value of the diet, is always the

[1] "Investigations on Bengal Jail Dietaries, with Some Observations on the Influence of Dietary on the Physical Development and Well-being of the People of Bengal." By Capt. D. McCay, I.M.S. Pp. iv+226+15 charts. (Calcutta: Government Printing Office, 1910.) Price Rs. 2.6 or 4s. 3d.
(Scientific Memoirs by Officers of the Medical and Sanitary Department of the Government of India, New Series, No. 37.)

cause of an actual increase in the amount of protein absorbed, and has shown that some improvement in condition attends this alteration. His work promises, therefore, to be in a very real sense of economical value to the Government, indicating a better maintenance of health on wisely diminished rations. This statement also applies to his study of the salt requirements of these diets, which lead him to the conclusion that more salt is supplied than is useful, and that the excess is detrimental.

The author has carefully studied changes following an increased absorption of protein from the diet, and presents an admirable case for discussion alongside the valued contributions of Chittenden. He has enlarged his presentation of this case by reference to the habits of the different native races within his view. According to him, these races may be arranged in a series, in which virile characteristics vary directly with the protein value of the diet, and are greatest where, as amongst flesh-eaters, this value is at a maximum. Carnivorous man sets to his work with zest, and is prepared to labour strenuously, and, if need arise, fight for life. The vegetarian spends a gloomy existence, embarrassed by an internal tangle of cellulose, and is swept off by feebly resisted disease. Some of the evidence offered in support of this contention is not of the same value as that in the remainder of the report, but it is highly interesting, and has been usefully published.

Prof. McCay is to be congratulated upon a report that should be found in every library of physiological literature. The opportunities provided by such a systematic observation of human beings under very precise control are great, and have been well utilised.

J. S. MACDONALD.

RECENT PROGRESS IN AËRONAUTICS.[1]

THE sudden development of the art of flying which has come upon the world during the last few years may be classed as one of the most extraordinary events in the world's history. We have had far-reaching inventions introduced before, such as the railway, the telegraph, the telephone, the motor-car, and many others, but all these have gradually developed, have sprung from small beginnings, and often it seemed doubtful whether they would ever develop into utility of real importance. With the flying machine it is different. True it is that the advent of such an apparatus has been foreseen, not merely for some years, but for centuries. The inception is very old. Like the sailor's story to his incredulous grandmother of the flying-fish, so a hundred years ago no one would have been dumbfounded if one had prophesied that men would fly, although one would have been accused of talking nonsense had one foretold that we could talk along a wire hundreds of miles long, see bullets embedded in the lungs, or be able to reproduce a song sung by one departed. We dare not at present hazard a guess as to what the flying-machine may eventually develop into. There are still those who think it will never be much more than a curiosity, but there are others who believe it will soon become our usual mode of travel, and that railways, steamboats, and motor-cars will have to take quite a back place in comparison.

My object to-night is not to give a full history of the navigation of the air. That is getting into a big subject that would occupy a long time to properly relate. Nor is this to be a very technical lecture; I propose now merely to refer to the latest developments—to trace some lines of thought which I hope may serve as a basis on which my hearers may build more solid structures for the improvement of the navigation of the air.

Aërial machines have been classed under two headings, known as lighter-than-air and heavier-than-air. I do not purpose going very deeply into the question of the first class, because I am inclined to think it is a subject of comparatively little importance, the latter having made such very much greater progress of late, and being able to effect almost all that the dirigible is designed to do and with greater ease and efficiency, that it seems likely to entirely oust the former.

A few words, however, on gas-borne vessels may be desirable to point out how they have been evolved, and in which direction improvements may be looked for, should their development be considered advantageous.

Balloons.

First we have to consider that simple contrivance the balloon, by means of which men have, for the last century and a quarter, been able to rise in the atmosphere and drift with the wind wheresoever it listeth. It is a remarkable fact that, notwithstanding the great hopes it raised in early days, scarcely any improvement has been made in this contrivance during a hundred years of practice. This refers to the simple balloon. Almost immediately after its invention suggestions were made to form it as a long vessel and propel it with screws, and though to-day we have the practicable dirigible balloon, it is probable that no invention has been longer in developing. Step by step it has grown from the ideas of Meusnier, through the crude machines of Giffard, de Lôme, Tissandier, to the first successful vessel, that designed by Colonel Renard, nearly thirty years ago. Though much progress has been made since, it has always been slow.

Santos Dumont evoked much public interest with his little vessels; Count Zeppelin certainly made a big step forward with his large rigid-framed leviathans, while Parseval, Gross, Julliot, and others have further developed the invention. From Giffard's steam engine of 3 horse-power to the 500-horse motor of the Siemens-Schuckert, every variety of engine has been tried, continually increasing in power.

Nor does it appear that any very revolutionary advancement is likely to be effected in the future with dirigibles. We may hope to go on making each vessel a little better than the last, much in the way in which steamships have progressed.

Undoubtedly the main path along which improvement is possible and desirable is that of speed. So long as an aërial machine is only able to progress at a rate not much above that at which the wind usually blows, it is bound to be very dependent on the ever changeful weather. A dirigible can never be considered really practical (in this country at least) until it is capable of travelling at, say, 40 miles an hour. This is a speed not yet attained by any dirigible. The wind at one or two thousand feet up frequently blows at 30 miles an hour, and not only must we be able to make head against this, but we ought to be able to progress fully 10 to 20 miles in the teeth of it. Now, considering for the moment solely the lighter-than-air machine, given a certain weight of engines, since buoyancy is dependent on displacement, we cannot make the vessel any smaller if it is to lift the weight. In order to increase its speed, then, presuming the shape and the surface and fittings to be such as to offer a minimum of resistance, there seem but two possible means. One is to make engines more powerful for their weight, and progress in this line seems moving rapidly. The other is to increase the size of the gas-holder. As the volume is enlarged the lifting power (and hence ability to carry more powerful engines) is increased at a greater rate than is the cross-section and surface, and consequent resistance. So we get the tendency to construct huge machines ever growing larger. This size, however, is one of the greatest practical drawbacks to the employment of such vessels. It is true there is plenty of room in the sky, and if the machines had to remain always aloft there might be no difficulty. But to be of use they must come to earth, and the enormous bulk has to be held stationary against any wind that may happen to blow. This is exceedingly difficult, and necessitates the use of sheltered harbours and sheds to house these monstrous structures, which implies vast expense.

There is, however, yet another means by which it may be possible to increase the speed without adding to the bulk. It is one that has often been suggested, several times tried on a large scale, but does not seem to show signs of general application. I refer to the use of horizontally disposed surfaces known as aëroplanes. If we have an apparatus travelling at, say, 30 miles an hour, and we add such devices, it will be found that they give a very considerable extra lift, and this may be utilised for raising an extra weight of engines. By adding to the propulsive power we both increase the speed, and thereby

[1] Paper read before the Junior Institution of Engineers on April 11, by Major B. Baden-Powell.