the obscurity attaching to the subject of Abyssinian ethnology:—

Table of Abyssinian Races

Hamites. (Agaü Stock.)	*Mixed.*	*Semites.* (Himyaritic Stock.)
Aghagha, prov. Aghaumêder.	(Hamites & Semites.)	Tigré, N. and E. of River Takazzé.
Hamra, prov. Lasta, S. Tigré.	Bogos, extreme N.E.	Samhar, on coast near Massowah.
Falasha, mainly in Semyen.	Gongas, about Gojam.	Shoho, S.W. of Massowah.
Kwara, W. and N. of Aghaumêder.	Gurâgwe, extreme S.	Menza, N. of Hamasen.
Khamant, chiefly in Dembea.	Kunama, N.W. towards Taka.	Habab, Bediuh, Takwé, Marea, Barea, — N. & N.E. frontiers Tigré.
Fighen, S.W. from Lake Tsana.	Shoa, S.E. corner.	
Zalan, chiefly in N. Amhara.	Amhara, between the Takazzé and Abai.	
Witos, about Lake Tsana (?).	King Theodore.	
	Prince Alumayû.	

Of the languages three only are of any literary or political interest: *Ghêz*, still surviving as the language of the liturgy and Sacred writings, though scarcely understood even by the clergy; *Tigrâi*, its purest modern representative, current throughout the kingdom of Tigré and generally north and east of the Takazzé; *Amharna*, spoken with considerable dialectic variety in Amhara and Shoa. All are written in a peculiar syllabic character showing certain affinities to the Himyaritic rock inscriptions of Marah and other parts of South Arabia. Amharic employs seven additional letters for sounds not occurring in Ghêz or Tigrâi, making with the vocal modifications a total of 249 distinct symbols. This was the language of Prince Alumayû. A. H. KEANE

COLOUR-VISION AND COLOUR-BLINDNESS

AS the notices of these subjects which have recently appeared in NATURE appear to me to do scant justice to the received theory, will you permit me to call attention to a portion of the evidence on which this theory rests?

The *Philosophical Transactions* for 1860 contain a paper by Prof. Clerk Maxwell, in which actual measurements are given of the quantitative relations between various colours, some of the observations having been taken by persons of normal vision, and others by a colour-blind person. The instrument of observation consisted of a species of spectroscope with three parallel slits, the widths of these slits, and also the distances between them being variable at pleasure. By this means three overlapping spectra are obtained, and any three spectral colours can be mixed in any proportions. The observations showed that any four colours as presented to the eye in a given spectrum are connected with each other by a definite colour-equation, such as—

$$3A + 4B = 2C + 6D,$$

which means that if the four colours A, B, C, D, as they exist in the given spectrum, are increased in intensity threefold, fourfold, twofold, and sixfold respectively, and then mixed two and two, the mixture $3A + 4B$ will present exactly the same appearance as the mixture $2C + 6D$. This is only another way of saying that colour as seen by normal vision contains three independent variables, or requires three numbers for its specification. Any three colours of the spectrum will serve as the three specifying elements; for example, if we employ A, B, and C to specify D, the specification will be—

$$D = \tfrac{1}{2}A + \tfrac{2}{3}B - \tfrac{1}{3}C.$$

Here we have one coefficient (that of C) with the negative sign. The three primary colours are defined to be those which will always have positive coefficients when they are employed as the specifying elements. In plainer words, all other colours can be exactly imitated by mixtures of the primaries, whereas, in the above example, the colour D cannot be imitated by a mixture of A, B, and C.

The points of the spectrum at which the three primary colours are found, will not necessarily be the points which most strongly excite the three elementary colour-sensations respectively. On the contrary, as a matter of fact, the two extreme sensations (called by Maxwell the *red* and the *blue*) are very feebly excited at the parts of the spectrum where they are purest, namely, at the extreme ends of the spectrum; and the middle sensation, which is largely adulterated with the other two even at the point where it is purest (namely, at a point in the olive green, which is, accordingly, one of the three primaries), has not a maximum of intensity at this point, but increases in intensity as the brightest part of the spectrum is approached, and attains its maximum (for the solar spectrum obtained with a flint glass prism), somewhere between the fixed lines E and D. The determination of the position of the middle primary in the spectrum, was made with considerable precision in the paper referred to; but the faintness of the two extremities of the spectrum rendered wide slits necessary in examining these regions, and thus introduced inaccuracy in determining the positions of the two extreme primaries, which in later publications Prof. Maxwell places at the very extremities of the spectrum.

The latter part of the paper of 1860 consists of a postscript containing observations made by a colour-blind person. The colour-equations found by direct observation are given, and are shown to agree with the supposition that the observer's vision was dichroic, the sensation corresponding to the extreme red being absent. The curves of intensity for each of the two elements in the vision of the dichroic observer are given, side by side with the three curves of intensity for the vision of a trichroic observer, all these being directly calculated from the observations, and the two dichroic curves appear to be practically identical with two of the three trichroic curves.

Dr. Pole's objection to the received theory appears to me to have no force except in so far as it is an objection to a name. The colour which the colour-blind see in the less refrangible half of the spectrum appears to be due to the excitement of the middle one of the three elementary sensations of trichroic vision. Persons of normal vision never get this sensation without large adulteration, and hence ordinary language contains no appropriate name for it.

Prof. Hering's theory of colours, as expounded by Dr. Pole (NATURE, vol. xx. pp. 479, 480) seems inconsistent with the fact (established by the observations of Prof. Maxwell, Lord Rayleigh, and other competent observers) that there is one definite colour-equation between any *four* colours. For Prof. Hering's theory assumes four elements of colour-sensation, R, G, B, Y, such that

$$R + G = 0, \; B + Y = 0.$$

It would follow that, with the help of the minus sign, all colours could be specified in terms of R and B, and hence by writing down the specifications of any three colours, and employing the ordinary processes of elimination, a colour-equation could be obtained between the three colours. Prof. Hering's theory then leads to the result that there is a definite colour-equation between any *three* colours; in other words, that when any three colours are given it is possible to imitate one by a mixture of the other two. This result is so utterly opposed to fact, that a theory which leads to it cannot stand for a moment.

J. D. EVERETT

SOME OBSERVATIONS ON FLEUSS'S NEW PROCESS OF DIVING AND REMAINING UNDER WATER

I HAVE recently had two opportunities of seeing a new process of diving and of remaining for a long time under water, called, after its inventor, Fleuss's process. The peculiarity of it is that the diver takes down with him such a good and wholesome supply of air-food, that he is quite independent of any supply from above, so that there is no pumping required, and, indeed, no help whatever, except a signal-man and cord.

The experiment is being shown daily at the Royal Polytechnic Institution, and I am indebted to the managers for giving me the earliest notice of it, and for offering me every facility for observation. I am equally indebted to Mr. Fleuss for his readiness to carry out my wishes, and I am sure the readers of NATURE will be interested with the facts I have now to offer them.

Mr. Fleuss, the inventor of the apparatus, is a young Englishman, twenty-eight years of age, who has served, I believe, as an officer in the P. and O. Company's service. He has constructed the apparatus himself in a skilful but not very ornamental fashion, and he is his own diver. He went down in the apparatus, like a brave man, first himself, and he only, up to the present, has been down in it. He is a short slight man, of fair complexion, and very pleasing expression. He has a quiet and resolute enthusiasm which is quite refreshing.

The dress in which he descends under water is like an ordinary diver's dress. A helmet, a breast-plate, and the common water-tight armings and leggings. He bears on his shoulders a weight of 96 lbs., and his boots are weighted to 20 lbs. At twelve feet depth he moves comfortably in the water under this pressure. From the helmet there proceeds a light cord for signalling to the signaller above.

Before the helmet is fixed and the mask closed, it is seen that he wears, firmly tied over his mouth and nose, an ori-nasal mouth-piece, from which a breathing-tube of an inch bore proceeds downwards. This mouth-piece is, in appearance, just like the chloroform mouth-piece invented by the late Dr. Sibson, and afterwards added by Dr. Snow to his chloroform inhaler. For many years I used invariably the same kind of mouth-piece for administering volatile anæsthetics, but Fleuss's fits much closer, and is fixed more firmly.

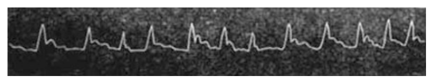
When he is on the floor of the tank, Fleuss moves about as he pleases, apparently without any impediment whatever. He can pick up coins, he can sit down, and he can even lie down and get up again, a feat, I believe, entirely novel in diving. He breathes, he assures me, just as easily as when he is in the air and quite as freely, and from what I observed when he came out of the water from a long immersion, I have no doubt as to the correctness of his statement. He has some means of disposing of the products of respiration as well as of getting a continuous supply of air for respiration, since there is no escape of expired air from him into the water.

On the first occasion on which I witnessed the experiment Mr. Fleuss remained in the water twenty minutes. He came out quite free of any oppression. His pulse was steady, his breathing free, and his complexion natural. This was considered a short experiment, and on Saturday last, November 15, therefore, I asked to see it prolonged to an hour and to be allowed to follow it through all its stages. The request was immediately granted.

The diving-dress was adjusted on Saturday, at 6.33 P.M., and then Mr. Fleuss began to breathe from the apparatus. At this time his temperature was quite natural and his pulse was beating steadily at 68 per minute; the pulse was of good strength and tone. The temperature of the air was 51° F.; of the water, at the upper surface, 49° F. Fleuss said it was colder lower down, but the difference was not determined. He descended at 6.40 and remained under the water, at a depth of twelve feet, precisely one hour, namely, until 7.40 P.M. He walked about the greater part of the time, picked up pennies, and once or twice partly reclined on the floor of the tank. At the end of the hour he gave the signal to come up, the cold of the water having caused great numbness in his hands; he walked up the steps, carrying the heavy weights (116 lbs.) briskly, and was relieved, after a short delay, first of his helmet and then of his mouth-piece. At this point I found his pulse to be beating at 120 per minute and somewhat feeble, but the face was clear of any sign of asphyxia, though it was a little pale. His breathing was quite free. He attributed the quickness of the pulse to the labour of carrying the weights up the ladder, and no doubt correctly. Seven minutes later, the dress having been removed and warm clothing put on, I found the pulse to be ninety per minute, and the temperature of the body, taken from the mouth, to be 94° F., rather more than 4° below the natural standard. At twenty minutes later, that is to say, at twenty-seven minutes after release from the water, the pulse was eighty per minute, while the temperature had risen to 96° F.

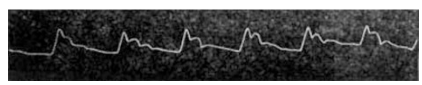
At this stage I took an observation of the pulse with the sphygmophone. The three natural sounds were perfectly clear and in regular order, but the first or percussion impulse sound was extremely tremulous; the second or recoil sound was slightly tremulous; the third was clear.

I next took a sphygmographic reading of the pulse, in which all the events belonging to the natural pulse were distinctly marked. The impulse stroke was short, as was also the first descending stroke; the second ascending stroke was decisive, and the intervening lines between the third and the recurrence of the percussion stroke were shorter than is natural to Mr. Fleuss, as will be seen from the comparison of the two annexed sphygmographic tracings, 1 and 2.



1. Pulse tracing after one hour's immersion in water at 49° F. Temperature of mouth 96°, pulse beat 80 per minute. November 15, 8.15 P.M.

For the sake of comparison I took a subsequent tracing of Mr. Fleuss's pulse on the morning of Monday, November 17, after breakfast. His pulse was at 68 per minute, the same as it was on Saturday just before he entered the water. It will be seen to be a pulse naturally slow and steady, but not very powerful.



2. Tracing of pulse in its natural or ordinary condition under the same pressure. Beats 68 per minute. November 17, 10.30 A.M.

At forty-seven minutes after his release from the water the pulse had come down to sixty-eight beats per minute, and the temperature had risen to 97° F. Ten minutes later still the temperature was 97°·6 F., eight-tenths of a degree below the natural. At this time my observations ceased.

The facts above narrated prove that, without assistance from above, a man who has had no previous experience of diving or of remaining under water can take down with him sufficient oxygen to live there easily for an hour. Mr. Fleuss assured me—and I see no reason to doubt him—that but for the cold he could have remained another hour and a quarter, and that he could easily arrange to remain four hours. Depth would make, he said, no difference as to breathing within the apparatus.

The mode by which the breathing is effected remains a secret, but is, he says, extremely simple. At my first observation, when he was under water twenty minutes only, I thought it possible that he carried down sufficient compressed air to live upon, and that he had a means for allowing the expired air to escape into the water. The later experiment shows me that this view was wrong. He could not carry down in the dress sufficient air to last him over an hour, and he does not seem to give out the expired air. I have no knowledge from him or any one how he breathes in the dress, and although I see how it could be effected, I think it right to leave it to Mr. Fleuss himself to describe the principle of his invention whenever he thinks, from his experiments, the fitting time has arrived.

In whatever way Mr. Fleuss gets breathing-room under the water, he has, without a doubt, achieved a great practical success. He has learned how to live independently for a long time shut off from all external access of air. He has learned, if I may so say, to become artificially amphibious, and if his plan succeeds, the cumbrous diving-pumps are done away with and the art of diving is vastly simplified.

Again, if he can live so long on the small reserve which he carries down with him in his dress, he has only to enlarge the dress, to expand it, that is to say, into a submerged vessel, to be able to go anywhere under the sea and do with intelligence what is now left to unintelligent mechanism. What such an intelligent direction might do with torpedoes it is not at all pleasant to contemplate.

The plan may be used for the purposes of deep-sea exploration, and the suggestion I made respecting my Salutlanders, that they sought for discoveries on the floors of the great oceans, may be so much nearer to accomplishment than the time which I assigned to it, that I may haply live to have the return laugh at what was called "the most visionary of speculative fancies." It is equally probable that the aëronaut may be able to rise much higher than he has yet done in this dress, or in a car specially constructed on a similar plan.

The apparatus may almost certainly be applied at once to another service very different in kind and on land instead of water. When a man can move about with an air-supply in his pockets, so to speak, he can go into fire as well as water. In a fire-proof non-conducting dress, provided with Fleuss's breathing apparatus, a fireman could enter a burning house, and without danger of suffocation go wherever the weight of his body could be borne.

Lastly, in wells charged with foul air, or in mines charged with choke-damp and other poisonous gases, the Fleuss apparatus will, I feel certain, prove of the greatest practical service, and I am happy in being the means of introducing it at length to the notice of my *confrères* in science.

BENJAMIN WARD RICHARDSON

NEW GUINEA[1]

BEFORE us lies one of the earliest published maps in which New Guinea is laid down. It belongs to Huygen van Linschoten's book of East Indian voyages, and was published in the year 1595, being derived largely from Portuguese sources. The map is turned on one side as compared with our present ones, so that at the top, on one hand, appears Japan, strangely shaped, and with the names of the cities curiously spelled, Meacum (the capital, Miaco, Kioto) and Tochis (Tokio?): whilst on the other hand lies New Guinea. At the foot of the map are Sumatra and the Bay of Bengal, and on the left hand China stands prominently upwards from the base of the map, with a camelopard walking about in its midst, regardless of the rules of geographical distribution. The north point lies to the left hand of the map, and the south to the right. New Guinea is represented as a very large and elongate island, the south coast being drawn without definite outline as unexplored, but with the Aru Islands duly shown lying off it. The great island is marked "Os Papvas," and at its eastern corner is the inscription "Hic hibernavit Georgius de Menezes." Although Antonio d'Abreu and Francisco Serraõ possibly sighted the New Guinea coast in 1511, Dom Jorge de Menezes must be regarded as the actual discoverer of the island. He was driven by the prevailing monsoon out of his course far to the eastward, when attempting to reach the Moluccas, from Malacca, by a new route round the north of Borneo in August, 1526. Having thus reached an island lying off the coast of Papua, he had to "winter" there, that is to say, to wait for the periodical change of the monsoon. According to Oscar Peschel, the island at which he remained, and which was called Versija, was very possibly one of those lying off Geelvink Bay. It is remarkable how very slowly our knowledge concerning New Guinea grew through the explorations of successive voyagers, since the time of Meneżes until within the period of the last ten years, and even now it is quite startling to pick up a small octavo volume and find it jauntily entitled "A Few Months in New Guinea," as if New Guinea were as familiar and accessible a place as say Iceland or Norway, about which such little books are commonly written by enthusiastic tourists.

We are sorry, indeed, that Mr. Stone's book is so little, and would have been glad if it had been three times as long, and he had given us further details of all kinds

FIG. 1.—Vahu, a Motu youth.

concerning his most interesting sojourn amongst the Motu people of the coast, whose God dwells out over the sea, and the mountain-dwelling Koiaris, who believe the dread "Vata" inhabits the mountain summits.

It is close to the east end of New Guinea, and on its southern shore beneath the Owen Stanley range of mountains that the Motu country lies. Mr. Stone first made an excursion from Cape York, in the small mission steamer *Ellengowan*, up the Maikasa or Baxter River, the mouth of which, on the New Guinea coast, lies due north of the Cape, just on the opposite side of Torres Straits. The river was traversed for sixty-four miles, but then forked, and since both channels were too narrow for the steamer to turn in, further progress was stopped. At this distance even from the river's mouth, native plantations of yams, sugar-cane, and tobacco were found. A further distance of twenty-six miles was traversed in a small boat, and large numbers of the recently-discovered species of Bird of Paradise, *Paradisea raggiana*, were met with. The bird does not croak like the Great Bird of Paradise of the Aru Islands, "wauk wauk," but utters "a peculiar whistle resembling that of a man to his dog," and must

[1] "A Few Months in New Guinea." By Octavius C. Stone, F.R.G.S. (London: Sampson Low and Co., 1880.)