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OF THE
CAMBRIDGE ANTHROPOLOGICAL EXPEDITION
TO
TORRES STRAITS.

VOLUME II.
PHYSIOLOGY AND PSYCHOLOGY.

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PREFACE.

During the years 1888-89 I spent some eight months in Torres Straits investigating the marine zoology of that district, and having become interested in the natives I devoted my spare time to recording many of their present and past customs and beliefs. Some of the results of these studies have already been published. Later I proposed to publish a Memoir on the Ethnography of the Islands of Torres Straits, but on going over my material I found it was too deficient to make into a satisfactory monograph. I then determined to go once more to Torres Straits in order to collect more data, with a view to making, with the aid of colleagues, a complete study of the people as was practicable.

I had long realised that no investigation of a people was complete that did not embrace a study of their psychology, and being aware of the paucity of our knowledge of the comparative physiology and psychology of primitive peoples, I determined that this branch should be well represented. I was able to secure Dr W. H. R. Rivers as a colleague, and I gladly left all the arrangements of this important section of our work to him. We obtained the cooperation of Messrs C. S. Myers and W. McDougall, who undertook special branches of experimental psychology. Some assistance in this department was also given by Mr C. O. Seligmann.

Perhaps a few words are necessary to explain why we visited a district apparently so insignificant as Torres Straits. As explained above, I had a good deal of unpublished material on the ethnography of the people and it would naturally take a time to gain a good insight into the life of a people about whom a fair amount was known than to begin afresh on a new people. From what I knew of my old friends and acquaintances I was sure that we could at once get to work instead of having to lose more or less time while entering into friendly relations with a people who, after all, might prove to be suspicious and refractory. Our experience fully justified the good impression I had formed of the willingness of the Torres Straits Islanders to impart information and to render personal assistance.

For the special work we had to do it was necessary to visit a people who were amenable and with whom communication was easy; but, on the other hand, who were not far removed from their primitive past. This peculiar combination was found in these people.

This region has some ethnological importance as it is on the frontier between two large land areas inhabited respectively by Papuans and Australians, and it was a matter
of some interest to determine whether any mixture has taken place there and also to endeavour to find out if any traces could be found in the islands or on the adjacent coast of New Guinea of a migration of the Australian stock from North to South. The islanders are as a matter of fact distinctly Papuan.

The Moray Islands were selected for the most prolonged and detailed study on account of the difficulty in getting there. They lie out of the track of what little commerce there is, neither are they frequented by pearl-shellers or bleche-de-mer fishermen, consequently the natives have not mixed so much with Europeans and other alien races as has been the case at Erub (Darnley Island) and the western group of islands. On the other hand, the islands have been subject for a quarter of a century to missionary influence and teaching with the result that most of the natives are professed Christians, and for about ten years English has been taught to the children. The foreign cult and civilization have undeniably had some effect, but experience proved that they were not detrimental for many of the purposes of the expedition. Perhaps it would not be easy to find a more favourable spot for the study of a simple and primitive people.

The reports of the expedition will consist of several volumes, each of which will contain memoirs on related subjects. It is proposed to publish the various reports as they are completed.

A. C. HADDON.

JUNE, 1901.
PART I.

INTRODUCTION by W. H. R. RIVERS.

VISION by W. H. R. RIVERS.

1. PHYSICAL CHARACTERS AND DISEASES OF THE EYES.
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INTRODUCTION.

By W. H. R. RIVERS.

The work to be described in this volume of the Reports of the Cambridge Anthropological Expedition is the result of an attempt to study the mental characteristics of the natives of Torres Straits and the Fly River district of British New Guinea by the methods of experimental psychology.

This attempt was due to the initiation of Dr Haddon, and I should like to take this opportunity of saying how much those engaged in this work owe to his guidance and assistance. In our work in Murray Island we also owed much to the assistance of Mr John Bruce, who was in charge of the native school on that island, and the work during our short stay in Kiwai was similarly much helped by Mr Chalmers, who was in charge of the missionary station at Saguana.

The full account of the islands on which we worked and of the general characters of their natives will be given by Dr Haddon in other volumes of the Reports. Only so much will here be said as bears directly on the psychological work.

The chief part of our work was done on Murray Island by Messrs McDougall, Myers and myself. We lived on this island, which is about five miles in circumference, with a population of about 450, for four months. During the greater part of this time the other members of the expedition were travelling on the north coast of New Guinea. We had taken out with us the equipment of a small psychological laboratory, and the house in which we lived was fortunately large enough to enable us to fit up the more complicated apparatus, especially that for reaction-times, in one room, while other parts of the house and verandah were used for different purposes. After four months' work, Messrs McDougall and Myers went on to Borneo. The remaining members of the expedition stayed for about a week in Kiwai and for about a month in Maluag, in which islands the psychological work was done by myself with assistance from Mr Solignac.

We were able during our four months' stay in Murray Island to cover a fairly wide field in our work. The subjects, which were investigated, included visual acuity and sensibility to light difference; colour vision, including testing for colour-blindness, colour-mimicry, the thresholds for different colours, after-images, contrast, and
the colour vision of the peripheral retina, binocular vision; line-dividing; visual illusions, some of which were investigated quantitatively; acuity and range of hearing; discrimination of tone-difference; rhythm; smell and taste; tactile acuity and localization; sensitivity to pain; temperature spots; discrimination of weight and illusions of weight; reaction-time, including auditory and visual simple reaction-time and clonic-time; estimation of intervals of time; memory; mental fatigue and practice; muscular power and motor accuracy; drawing and writing; blood-pressure changes under various conditions, etc.

In some cases observations were made on a fairly large number of individuals; in other cases, little more could be done than to make a few observations with the object of ascertaining the most satisfactory methods in work of this kind. In some of the latter cases, though we can bring forward no positive results, I hope that we may furnish contributions to method which may be useful in future work.

Our stay in Kiwi was very short, and little more could be done than to examine as many individuals as possible in a few subjects such as visual acuity and colour vision.

In Melbing, in which island we made a longer stay, the work was limited in extent owing to the fact that most of the apparatus had been taken on to Birono. The subjects investigated included visual acuity, colour vision, auditory acuity, smell, tactile acuity, writing and drawing.

There were in the island of Melbing a number of Polynesian and Melanesian natives as well as some Australians, and a few observations were made on them. A few half-castes, chiefly with Torres Straits mothers and Polynesian or Melanesian fathers, were also examined. The account of these observations and of some made by Mr Saffgmann in New Guinea will also be included in this volume.

It will be impossible to give any general records of the work and its results until all our data have been worked out, and until other data have been collected for purposes of comparison with those derived from Torres Straits. Nearly all the methods used by us were modified in some way to meet the special conditions, and others were either entirely new or had not been employed on any large number of individuals. Consequently much of our work is at present in the form of mere facts which will only acquire interest and importance when we have examined a considerable number of Europeans and people of other races by the same methods. This will necessarily take time, and all that can be done in this introduction is to give a general sketch of the methods and the conditions under which they were employed.

Murray Island had great advantages for our work. With so small a population we were able to become more or less acquainted with nearly all the inhabitants, certainly all the males of the island, and were able to form a fairly accurate estimate as to how far the natives examined were representative of the whole community.

The people were sufficiently civilized to enable us to make all our observations, and yet they were sufficiently near their primitive condition to be thoroughly interesting. There is no doubt that thirty years ago they were in a completely savage state,

* The first teachers landed in 1867 (Duntulm Island) in 1871, and a few months later Malaita. the Life teacher, went to Murray Island.
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Absolutely untouched by civilization. Owing to its inaccessibility, Murray Island has been much less affected by outside influences than the other islands of Torres Straits.

Our work was much assisted by the fact that all the younger men spoke "pidgin" or trade English, while there were few who did not know it to some extent. In beginning any investigation we were able to learn, from some of the younger men, how Murray Island words bearing on the subject in hand, and it was then often possible to work with the older natives who knew very little English. At least one instance occurred in which the exclusive use of pidgin English might have led to serious error which was avoided by using the appropriate Murray Island terms.

We had little difficulty in getting the natives to make the observations we required. Owing to their previous acquaintance and friendship with Dr. Haddon, we found ourselves on our arrival already on the most friendly terms, and were able to commence work at once. There was no evidence that the people were afraid that our instruments would do them any harm, a difficulty which has been encountered among other races in such matters as testing eyeglass. We met with a certain amount of resistance in many cases, and a few natives in Murray Island avoided us altogether, but we had good reason to know that this was due to other reasons. The natives were told that some people had said that the black race could see and hear, etc., better than the white man, and that we had come to find out how clever they were, and that their performances would all be described in a big book so that everyone would read about them. This appeal to the vanity of the people and put them on their mettle, and in nearly all their observations there was no doubt that they were doing their best; in fact, I am doubtful whether, when collecting comparative data in some more or less primitive European community, it will be possible to excite the same amount of interest and to be certain that the observations are being made with care and conscientiousness equal to that of the Torres Strait Islanders. Some of our investigations were distinctly laborious and made a considerable demand on the attention, and in some cases there is no doubt that the natives were careless and did not try to do their best, but in most cases they exhibited a degree of application which was surprising in face of the widespread belief in the difficulty of keeping the attention of the savage concentrated on any one thing for any length of time. The cases in which it was most difficult to keep the attention of the natives were those in which they were deficient in any respect, thus I met with much difficulty in testing cases of subnormal eyesight. So long as they were doing well they were thoroughly interested, but the interest began to fall off directly they found that they were not as good as their neighbours. In all cases the natives were closely watched for any falling off in interest or attention, and if this showed itself the work was broken off and ten minutes or a quarter of an hour passed in smoking or looking over photographs or other recreation.

It was sometimes difficult to know what to do when a native was very reluctant to be examined in any given place. If he only consented unwillingly, there was the danger that he would not do his best, and that his observations would in consequence be unsatisfactory, but, on the other hand, it often happened that a native, who began...
his observations only after much persuasion, became interested as soon as he had begun and did as well as anyone else. The characteristic demonstrative nature of the Papuan was very useful here and always allowed one to see whether a native was trying to succeed or not.

The degree of trustworthiness of the observations was shown in several ways. In the first place, it was, as already mentioned, easy to tell from simple observation whether the native was giving his whole mind to the task in hand, or whether he was making his observations carelessly, and those facts of observation were noted at the time. In the second place, in the case of quantitative observations the mean variation (i.e. the mean of the deviations of the individual observations from the average of the whole number of observations) was a very useful index of the degree of concentration of attention. Those who had been noted as careless while making the observations were always found to have large mean variations, and I believe that the smallness of the mean variations in most of the quantitative investigations undertaken will convince those acquainted with the procedure of experimental psychology of the trustworthiness of the observations. Finally, I believe that when the account of our work is completed, the general consistency of the results will show that the observations must have been made with a due amount of care and attention on the part of the natives.

One of our chief difficulties was that of ensuring a regular attendance of natives to be examined. When we first started work a large proportion of the population used to arrive and we were surrounded by a noisy crowd which made serious work impossible. On other days owing to some counter-attraction we were deserted and had to go and search out natives to be tested. Unfortunately much time was wasted for these reasons till, with the aid of Mr Bruce, we were able to arrange with the two Mannuas (chiefs) that a limited number of men should come regularly every morning. Harry and Pasi, the two Mannuas, making themselves responsible for alternate weeks. After this we had much less difficulty, though even then our men would sometimes fail to come, or would come very late on some days, while on other days, owing either to rumours that we had some new attraction, or to lack of attractions elsewhere, we were invaded by a large number of natives. The people who came for medical or surgical treatment were also a valuable source of subjects for observation.

We found after a time that men from Les and other villages at the opposite end of the island were not coming to us and it turned out that this was due to the fact that an enthusiastic native, in insisting on the importance of truthfulness in their intercourse with us, had announced that if they told lies Queen Victoria would send a man-of-war to punish them, and this had so alarmed the people of Les that they thought it prudent to absent themselves altogether.

It appeared to be almost impossible to get the men to come to us in the afternoon and we therefore devoted this part of the day to work with the children. Mr Bruce kindly sending us from school any number that we wanted. The children regarded it as a great privilege to come to us and in consequence their observations were made with the greatest care and attention. In many cases their observations were distinctly different from those of the adults, a fact probably due to their school...
INFORMATION.

Instruction, though some of the youths and younger men had also received instruction from Mr. Bruce, and from Mr. Hunt and other missionaries before Mr. Bruce’s arrival in the island.

Each man who came for a morning’s work received a stick of tobacco at the end of the morning and the children received sweets. It is perhaps as well to mention that most of our observations on adults were made under the influence of tobacco.

I am not aware of any recorded investigation, even on civilized subjects, which resembles our work in Murray Island. Those who have employed the methods of experimental psychology in observations on numbers of individuals have usually obtained their information by a series of tests so devised that a more or less complete examination of an individual can be made on one occasion, usually within the limits of an hour. Thus is Gollner’s extensive observations, made at exhibitions and at the anthropogenetic laboratory at Bernhurst Kensington, the time devoted to each individual was about half-an-hour.

Cattell and Münsterberg have published schemes for the examination of an individual which would take about one hour, and the former, in conjunction with Farnard, has published results in which the observations were made within this limit of time. Jastrow and Marchwood have published the results of mental tests in which the time devoted to each individual was 50 minutes. In a discussion on mental tests by a committee appointed by the American Psychological Association, it seems to have been understood that such tests should not occupy more than one hour.

Binet and Henri have published a much more extensive scheme of observations in individual psychology, but up to now no systematic observations were made on the lines of this scheme have been published.

In a recent investigation by Sharp more extended observations have been made, but only on a few individuals, and the mental attributes tested were of a more complex nature than was possible in our work.

Our work in Murray Island differs from such investigations in that we examined most of the male members of a small community among whom we lived and with many of whom we became very intimate. We had, in consequence, many opportunities of general, as well as of experimental, observation. Secondly, our investigation was carried over several months, so that a certain number of individuals were examined many times and in different subjects of interest on different days, so that the fatigue induced by one set of observations did not influence other measurements, as must be the case when a number of observations are taken rapidly one after the other. In any given subject of investigation as many observations were made as the power of attention of the individual allowed. The multiplicity of observations in
any given measurement is not only important in giving a more satisfactory average, but it allows one to form some idea of the influence of such factors as constancy of attention, fatigue and practice, which are quite as interesting in many cases as the special measurement that is the immediate aim of the investigation.

In a few cases the investigation of a given subject in an individual extended over two or three days and in some subject, viz. the influence of practice on mental work, observations were made at intervals of several weeks, but, as a general rule, a result was obtained in one sitting, although one often had, owing to the influence of fatigue, to be content with a rough and approximate determination of the measurements in question.

In the case of quantitative observations, the results will usually be expressed in the form of the average, while the accuracy and constancy of observation will be expressed by the mean variation, obtained by finding the arithmetical mean of the deviations of the individual observations from the average. In some cases in which sufficient observations were taken, the median value will also be given, viz. the value which stands exactly in the middle of all the figures obtained when these are arranged in order of magnitude.

In order to express the degree of variability of the individuals in any subject of investigation, the mean variation of the figures for the individual natives will be given, i.e. the arithmetical mean of the deviations of the results of different individuals from the average result. This will be recorded as M.V. in capital letters in order to distinguish it from the mean variation of an individual which will be recorded as m.v. in small letters.

M.V. will be an index of the degree of variability of the different natives in any measurement, while m.v. will be a guide to the accuracy and constancy of a given native in that measurement.

I am afraid that the introspective aspect of psychological experimentation was almost completely absent in our work. Occasionally a native would be able to give useful information as to what he had in his mind while he was making a measurement, but as a general rule, no information of this kind was obtainable. It was, of course, possible in some cases that when a native was asked to do one thing, he was in reality doing something different, but this danger was avoided as much as possible by making every gesture as simple as possible, while the general consistency of the results renders any such fallacy very improbable. In fact, I believe that the results are in most cases even more consistent than those made by civilized people, and especially by students of psychology. The latter, when asked to make a given measurement are very apt to begin to speculate about what they are asked to do and allow their knowledge to influence their judgments. It is customary in experimental psychology to speak of differences of procedure according to the amount of knowledge of the experiment, which the observer possesses. One speaks of the procedure as "with complete knowledge," "with partial knowledge," or "without knowledge" ("wissenschaftlich," "halbwissenschaftlich," or "unwissenschaftlich"). It is almost impossible to have a completely "unwissenschaftlich" procedure in a student of psychology, while probably in no investigations has the procedure ever been so completely "unwissenschaftlich" as it was in our
work in Torres Straits, and I cannot help thinking that this had something to do with the general consistency of the results.

In several investigations statistics will be given on the influence of age. The determination of the age of an individual was by no means an easy matter. The ideas of the natives themselves on the subject were of the vaguest description, and their statement as to age in years absolutely unreliable. They nearly always knew, however, which was the elder of any given two men, and one was often able in this way to arrange a group of men in order of age. There were further a certain number of men whose ages were known approximately in some way, and this enabled one to roughly arrange the whole series. The ages adopted are chiefly based on information given by Mr Bruce, who has been keeping for some years a very valuable register of births, marriages and deaths in the island. This often contained important evidence as to age, thus, one man had been entered as 21 in 1890, another as 25 in 1894. In the case of those under 20 or 21, Mr Bruce was able to be more definite, as he had known them all as children. In the case of some children, assistance was also given by the fact that they were represented in photographs taken at the time of Dr Haddon's previous visit.

In Mabuiag and Kiwai, the determination of the ages was still less definite, and the ages given are based mainly on the general appearance, assisted in Mabuiag by knowledge on the part of the natives of their relative ages.
I. VISION.

BY W. H. R. RIVERS.

1. PHYSICAL CHARACTERS AND DISEASES OF THE EYES.

On examining the eyes in Mabia, I found a difficulty in getting an extensive view of the cornea and conjunctiva which I had not experienced in Murray Island, and it seemed to me that this was due to a greater narrowness of the palpebral space, but I have no direct measurements to show whether this was the case.

In nearly all cases the conjunctiva was pigmented. The pigmentation occurred in three chief forms. In many cases it was diffusely distributed over the conjunctiva, and, combined with considerable vascularity, gave the eye a yellowish appearance from a distance. In other cases, the pigment occurred in irregular patches. In some cases, these patches existed together with the diffuse pigmentation; in other cases, especially in younger men and children, the rest of the conjunctiva was white and clear. In many cases, the cornea was immediately surrounded by a definite ring of pigment, varying in breadth in different cases. A similar ring has been described by Perguson\(^1\) as occurring in the Congolese, which appears, however, from his description to have been broader than among the Torres Straits Islanders. Wolffmann\(^2\) has also described a circumcorneal ring in a Negro, and a similar ring may be seen in many animals. Perguson also observed patchy pigmentation among the Congolese, and the general appearance of the eyes of these people appears to have closely resembled that of the Torres Straits Islanders.

Perguson examined the eyes of a Negro who had died of tuberculosis and found that in the ring of pigmentation the superficial as well as the deep cells of the circumcorneal epithelium were loaded with pigment.

A definite acras semilis was found in several of the older men. An indefinite haziness at the margin of the cornea, more superficial than true acras, was very

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\(^1\) Jena, p. 420. 1899.
common and was especially marked in the upper segment of the cornea, over which it often spread for some distance. This blemish gave the outer edge of the iris a bluish appearance from a distance. Ahlborn has noticed a similar appearance among Javanese and Negroes. In 1843, Furniss noted some similar cases common among the Negroes and Arabs of Algeria, and this may have been of the same kind.

Opacities of the cornea were common and were often associated with tearing and distortion of the corneal margin. In some cases the opacities involved the centre of the cornea and were the cause of defective visual acuity. It is perhaps worth noticing that the most marked corneal changes were seen in natives living on the south-east side of Murray Island, i.e. the side exposed to the trade wind for about eight months of the year. This may simply have been due to greater exposure to dust, but there was also much reason to believe that this side of the island was less healthy in other ways.

A few cases of acute conjunctivitis were seen, both in Murray Island and Mabiling, of the phlyctenular form, but the phlyctenules were larger than those commonly seen in Europe. There were two men on Murray Island, Gasu and Kapilag, who were almost blind owing to injury in early life. In both cases, the cornea and conjunctiva were almost completely covered by scar tissue.

Pterygium and pinguecula were very common. All stages of pterygium were noticed, from slight thickening and vascularity of the conjunctiva to a thick growth involving the cornea for several millimetres. The condition was in nearly all cases most marked on the inner side of the eyeball; in some of the slighter cases there was no marked difference between the two sides, while in one man on Murray Island, Billy Gaeu, the pterygium in the left eye was distinctly more marked on the outer than on the inner side, involving the cornea for several millimetres. In no case had the pterygium spread so far over the cornea as to obscure the pupil in ordinary illumination.

In most of the slighter cases, the pterygial thickening of the conjunctiva led up to a pinguecula at the corneal margin. Pterygium and pinguecula are often described as separate conditions, but the cases in Torres Strait would certainly lead one to suppose that pinguecula forms one stage or part of one stage in the development of a pterygium. In some cases there was a well-marked pterygium on the inner side of each eye involving the cornea for some distance, while on the outer side of each eye there was thickening of the conjunctiva leading up to a pinguecula. Lopez, who finds pterygium extremely common in Cats, has similarly noted the close relation between the two conditions and regards pinguecula as the first stage of pterygium.

The two men, Papi and Billy Gaeu, in Murray Island in whom the condition was most marked were about 40 years of age, while in some of the oldest men it was very slight. The youngest individual in whom definite pterygial change occurred was Dick (son of Tolik), aged 11, in whom there was marked swelling on the inner side of the conjunctiva extending to the margin of the cornea. Liu, aged 14, also

1 Kita. Mammalol. J. Jap. Dr. 1498.
2 Ann. lxv. 1498.
had a very distinct pinguicula and commencing pterygium. Webster Fox noted the presence of pterygium in 65 of 230 American Indians examined by him, and as those were all under 23 years of age, it appears that both in Torres Straits and elsewhere pterygium may occur early in life. A large pterygium was noted in Bigfj, wife of the Manus of Murray Island, but I have not sufficient observations to say whether the condition was more or less common in women than in men. Lopez notes that in Cuba it is rare in women, and rarely found before the 30th year.

There was no marked difference in the frequency and severity of pterygium in Murray Island and Mabuiag, but it seemed to me to be less marked in Kwi and also in the village of Old Mawatta on the mainland of New Guinea, where I looked at the eyes of many of the natives, although I was not in the village long enough to make any observations on visual acuity.

The chief cause of the prevalence of pterygium is probably irritation from dust and the smoke from the wood fires. In the wet season the people sit round the fires inside their houses, which have very smoky means of outlet. Forques, who found pinguicula universal among the Congolese examined by him, states that this condition is attributed by the officials of the Congo to the influence of smoke within the huts but points out that this cannot be the only cause, for pinguicula is found in young natives brought up under the best hygienic conditions in Belgium.

It seemed in Murray Island as if the occurrence of pterygium had some connection with the general physique. Those in whom pterygium was well marked were not as a rule less healthy in appearance than the average, while the disease was almost absent in some of the strongest and healthiest natives.

In one case had pterygium affected the visual acuity (see p. 39).

One man had a tumour within the orbit on the outer side of the right eye. His vision with that eye was very slightly affected, but the chief interest of his case lay in the fact that he was the only native in whom I failed to obtain evidence of binocular vision.

Two men in Murray Island had advanced cataract. Dauni, aged 50 to 55, had a mature cataract in the left eye with only perception of light. In the right eye there was slight opacity of the lens with vision of 1/3. Jimmy Dei, aged 45 to 50, had distinct cataract in the right eye with vision of 1/3, slighter change in the left eye with vision of 1/3. Two other old men, the Manus, aged over 60, and Lai, aged 55 to 60, with vision of 1/3 and 1/3 respectively, appeared to have slight change in the lens, but I was not able to make satisfactory examinations. I think it probable that the early falling off in visual acuity with advancing age (see p. 29) was probably in many cases due to slight changes in the lens which I was unable to detect. The opacity of the lens which appears to be more frequent than in Europe was probably due to the influence of tropical light. I am unacquainted with any other observations on the relative frequency of cataract in temperate and tropical climates.

No case of cataract was seen in Mabuiag.

I did not notice any case of strabismus in Torres Straits. Guppy notes that it

3 The Schwenk Islands and Their Natives, 1887, p. 177.
PHYSICAL CHARACTERS AND DISEASES OF THE EYES.

is not uncommon among the natives of the Solomon Islands. Poeyens, on the other hand, observed no case among the Congolese, and states that medical officers on the Congo do not remember ever having seen a case.

PUPILS.

I did not make any measurements of the size of the pupils, but they were in general small; often, in a good light, very small. They were circular and I did not notice any cases of irregularity. I have found few references to the size of the pupils in different races. Guppy¹ was inclined to regard those of the Solomon Islanders as larger than in Europeans and ascribes their power of seeing in low illumination to this cause (see p. 39). Pursnani, on the other hand, noted that the pupils of Algerians are very small. Hylas and Deniker² give the diameter of the pupils in Fugiaus as varying from 2 to 4 mm.

I examined a good many eyes for eccentricity of the pupils; many were median, some slightly nasal and a few decidedly on the nasal side, but not more so than is common among Europeans. I did not note any cases in which the pupils were temporally eccentric. Kroebelmann³ has described the pupils of three Patagonians examined by him in Berlin as situated on the upper and nasal side and in two cases to a marked degree. It is perhaps noteworthy in this connection that in such eccentricity as existed in Torres Straits, the displacement was also nasal.

The colour of the iris will be considered in the volume on physical anthropology.

¹ loc. cit.
² loc. cit.
⁴ loc. cit.
2. VISUAL ACUITY.

Those who have travelled or lived in uncivilized parts of the world are fairly unanimous in ascribing to savage and semi-civilized races a higher degree of acuteness of sense than is found among Europeans. It is said that savages can see objects and hear sounds which escape the most acute Europeans.

Travellers have generally failed to distinguish between the two chief factors upon which the power of distinguishing objects by sight depends; one, visual acuity proper, depending on the resolving power of the eye as an optical and physiological mechanism; the other, which may be called power of observation, depending on the habit of attending to and discriminating any minute indications which are given by the organs of sense. Another fact which travellers have usually omitted to take into account is that the observations which have been held to show extraordinary sense acuity have been made in surroundings with which the savage is extremely familiar. A feat, which to the outsider may appear to depend on a marvellous degree of acuteness of vision, may depend merely on a correct inference founded on special knowledge.

Perhaps the most frequently quoted instance of extraordinary visual acuity in a non-civilized race is an observation made by Humboldt at Quito. Some Indians saw the white peak of Bonpland, Humboldt’s companion, at a distance of about 85,000 Parisian feet, and Humboldt calculated that this implied the power of distinguishing an object at a visual angle of 7° to 12°. Those who quote this instance do not, however, relate that both Humboldt and a Spaniard with him were able to distinguish the white object as soon as it was pointed out to them. The observation did not show any superiority of the Indian over the European in visual acuity, but only in his powers of observation.

Instances of acuteness of sight given by travellers could be multiplied indefinitely. I will content myself with giving two derived from Melaninian races alluded to those on whom my observations were made. In 1865, Brehmey noted that the men of

1 Keano, 1850, 32, au. p. 68.
Visual Acuity.

San Cristoval in the Solomon Islands had "eyes like lynxes, and could discover from a great distance, though the day was anything but clear, the pigeons which were in the trees hidden by the leaves." In 1886 Duffield notes that the keenness of sight of the natives of New Ireland was remarkable. "They could discover land which we were unable to make out with good glasses, and they would find out small boats 6 or 7 miles off in bad weather which we were unable to do with binoculars or telescopes." Duffield states that the Indians of the South American desert do not surpass or equal the New Islanders.

In 1890, a discussion on this subject was carried on for some time in the pages of Nature. The chief antagonists were Lord Raleigh and Mr Brenchall Carter. The former insisted that on theoretical grounds there were necessary limits to the resolving power of the eye, and believed that the highly developed visual powers of the savage depended on his attention and practice in the interpretation of minute indications. Mr Carter, on the other hand, was inclined to believe that the savage has much greater visual acuity than is possessed by the civilized man.

Since that time evidence has accumulated which enables one to speak more definitely than was formerly possible, and before considering the results obtained in Torres Straits and New Guinea a short account may be given of previous work and of the methods which have been used in ethnographical investigations of visual acuity.

Methods of Testing Visual Acuity.

The accurate definition of visual acuity is, unfortunately, a point on which ophthalmologists have not yet agreed. The most general view is that visual acuity should be measured by the minimum visual angle, that is, the smallest angle at which two points can be distinguished as such. Snellen however has defined visual acuity by the minimum angle at which the eye can recognize the form of an object, while Galloty has proposed that the smallest angle which an object must subtend in order that it may be seen at all shall be taken as the measure of visual acuity.

In practice the method which is most widely used is that of Snellen. The degree of visual acuity is measured by the distance at which letters of a given size can be recognized. The smallest letters used for distant vision subtend an angle of 5 minutes of an 1 minute, which has been found by experiment to correspond approximately with the minimum visual angle of normal European vision. In the accompanying letter, each of the 25 squares into which the letter is divided subtends an angle of 1 minute at 5 metres.

The degree of visual acuity (V) is usually expressed by the formula \( V = \frac{d}{D} \) where \( D \) is the distance at which a given type subtends an angle of 5 minutes, and \( d \) is
the greatest distance at which this type can be recognized; thus \( V = \frac{2}{3} \) or \( = 1 \) means that type subtending an angle of 5 minutes at 5 metres can be read at 5 metres; \( V = \frac{4}{5} \) or \( = 2 \) means that type subtending an angle of 5 minutes at 5 metres can be read at 10 metres; and \( V = \frac{3}{4} \) or \( = \frac{3}{2} \) means that type subtending an angle of 5 minutes at 10 metres can only be recognized at 5 metres. When \( V = \frac{3}{2} \) or 1, vision is usually spoken of as normal, but this does not mean that it represents the average vision of Europeans. This formula is especially used by clinicians who are chiefly interested in subnormal vision and especially in cases of abnormal refraction of the eye. Their object is to improve vision by glasses till \( V = 1 \), which they regard as good enough vision for practical purposes, and the normal in an arbitrary case chiefly adopted for clinical purposes. The true European normal, the average vision of Europeans with normal eyes, has not yet been satisfactorily determined, but, as we shall see, enough has been done to enable a rough comparison to be made between the visual acuity of Papuan and other primitive races and that of Europeans.

A distinction has been made by Cohn\(^1\) between visual acuity (Schärfstar) and visual efficiency (Schleisung) which is of some importance for ethnographical purposes. By the former term is meant the acuteness of vision after any existing defect of refraction of the eye has been corrected by glasses, while by visual efficiency is meant the acuteness of vision without any artificial aid.

In most savage races in whom abnormalities of refraction are rare, there would be little difference between the average visual acuity and the average visual efficiency, while in civilized countries the difference might be considerable. The savage and the civilized man might differ very little in visual acuity in the strict sense while differing greatly in visual efficiency. In this work the term "visual acuity" will be used to cover both forms, but in special instances the distinction will be noted.

Although useful for practical purposes, the recognition of letters is unsatisfactory as an exact method of testing visual acuity. Some letters are recognized at much greater distances than others, and the degree of familiarity with letters is also of great influence, for anyone thoroughly familiar with the forms of different letters may often guess successfully when he sees the letters very indistinctly. For ethnographical purposes it is obvious that the method can be of little value.

For testing literates Snellen devised a test consisting of squares with one side open and on the same scale as the letters. These are often called Snellen's Haken. This test was found to give results which were not comparable with those obtained by the letter test, and Snellen further modified the test by using the letter \( E \) in different positions. The individual who is being tested may say which side of the \( E \) or \( E \) is open, or may place an \( E \) held in his hands in the same position as one pointed out to him. This method has been used in ethnological investigations, and is that which was found to give the most satisfactory results in Torres Straits.

Cohn has devised two modifications of the test, especially for ethnographical

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1 Snellen, who first adopted a letter subtending an angle of 5 minutes as the unit, acknowledged that this unit was arbitrary, but thought that it probably represented average visual acuity if the eyes of advanced age were included.

VISUAL ACUITY.

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purposes. In one, 36 letters, all of the No. 6 size, are placed on one square card which can be hung up by each of its four sides, giving a very large variety of possible positions of the E unless excluding the possibility of learning by heart. Color had the large number of letters on this card made it difficult in some cases to tell which E was being indicated, and he therefore devised another modification in which a circular card is used on which eight letters are placed. The card can be turned around behind a cover in which there is a circular aperture through which one letter can be exposed at a time. This form of the test quite does away with the danger that the position of the letters may be learned by heart.

Steiger* has proposed a modification of the original test of Snellen’s Haken (squares open on one side) in which smaller sizes are used so that all degrees of hypermetropia can be tested at a distance of 3 meters. These types can be used both for near and far vision.

Laudol† has recently proposed a modified test on the same principle as the E test, consisting of circles presented at some point in their circumference a gap corresponding to an angle of one minute.

Before going out to Torres Straits it seemed possible that any tests involving the recognition of unfamiliar objects, such as letters, might turn out to be impracticable. Mr. Marcus Grace suggested to me that types representing the human hand with one or more fingers missing might prove more interesting to the natives than the ordinary tests and might give better results. I had such tests prepared, the fingers of the hand being on exactly the same scale as those of Snellen’s letters. Owing to the fact that perfectly satisfactory results were obtained with the E test I did not find it necessary to use them.

Another kind of test which differs in principle and has been very largely employed in work on visual acuity depends on the power of counting dots. One form of this test is employed in the British services, consisting of black dots 3 mm. square on a white ground. This test was used by the Anthropometrical Committee of the British Association in the investigation of visual acuity. The test was found to have the disadvantage that the distances between the different dots were unequal, and the distance at which they could be normally counted, viz., 57 feet, was so large as to make it difficult to find suitable open places for the process of testing.

Buchard’s international visual tests depend on the principle of counting. They consist of round black dots on a white ground at distances apart equal to the diameter of the dots. They are arranged in groups of 4, 5, and 6. Another test similar in principle is Snellen’s test No. XXIV. This consists of white dots each 5 mm. in diameter on a black ground. Different groups of dots are exposed through an opening in a black screen. This method is perhaps the most satisfactory of those which depend on counting and I used it in Torres Straits. Any

1 i.e., subtending an angle of 5 minutes at 5 meters.
2 This may be obtained from Prussiank’s Buchhandlung, Brussels.
5 According to Durbach’s white dots on a black ground give the same results as black dots of the same size on a white ground.
method, however, which involves counting is unsatisfactory for ethnographical purposes (see p. 39).

All the methods which have been described are not quite satisfactory from the purely physiological point of view; they all involve either counting or recognition of form, i.e., they involve psychological operations, often of some complexity, although these are very much reduced in importance in the E method.

For the purpose of testing the eye as a physiological mechanism the method proposed by Galllcy is perhaps more satisfactory. By this method visual acuity is measured by the distance at which a black dot on a white ground becomes invisible. It has been objected that this form of the test is greatly influenced by the illumination and that it is a test of the light sense rather than of visual acuity. We know, however, that the illumination is of considerable influence in all the methods of testing visual acuity and within the ranges of illumination which occur in practice, it is very doubtful whether Galllcy's test is more influenced by differences of illumination than those in ordinary use.

In all methods of testing visual acuity, illumination is a matter of great importance. According to various investigators there is a progressive increase in visual acuity with increase of illumination up to a certain point beyond which further increase of illumination causes no increase in acuity, and may even lead to a decrease.

For ethnological purposes it will probably always be most convenient to test in the open air. Experiments by Seggel have shown that the distance at which letters and the E test-types are recognized is 2 to 3 metres greater in the open air than in a well-lit room. The illumination of the open air varies of course very greatly, not only in different parts of the world, but on different days in any one country. I have reason to believe, however, that the difference in the illumination on a bright day in Europe and in the tropics is not sufficient to erase any distinct difference in the degree of visual acuity. When testing visual acuity in England to obtain results for comparison with those obtained in Torres Straits I at first chose very bright days (in August, 1890) but I soon found that some of these days were too bright to give satisfactory results with Europeans. The glare (even with the sun behind the individual under examination) was too great for distinct vision and much higher values for the visual acuity were obtained by moving into the shade.

**Historical.**

The first exact observations on visual acuity from the ethnographical standpoint were made in the American army in 1895. The method used is not very fully described, but the white troops were examined with small pics, while in the case of coloured troops an individual was passed when he satisfied the examiner that he could recognize the form of a letter. It was found that the white soldiers could

1 Arch. f. Arzneikunde, Bd. xxv. S. 328. 1901.
read the type at 47.77 inches; full black at 45.33; mulatto at 47.23, and Indians (froquito) at 54.77 inches. The average Indian was slightly superior and the average Negro slightly inferior to the average white man but not in any marked degree.

In 1875 Callan examined 456 Negro children in New York schools. He found that 94 per cent. had normal vision, 26 per cent. were myopic, and 3 per cent. were amblyopic from some cause. On testing those with normal vision with Snellen's letter test, 67.8 per cent. were found to have vision from \( \frac{4}{4} \) to \( \frac{1}{4} \), 11 per cent. from \( \frac{2}{4} \) to \( \frac{1}{4} \), and 0.4 per cent. had vision of \( \frac{1}{4} \).

In 1879 Cohen examined 11 Nubians in a travelling caravan at Benin. It was found that the natives could count up to 4, and Snellen's Tabel Ey was therefore used on which the white dots should be counted at 16 to 27 metres. Seven of the Nubians counted correctly at 26 to 39 metres; while one probably of mixed Negro and Nubian blood was correct at 40 to 43 metres. One individual, the chief and priest, who could read Arabic, was myopic (\(-1.5\)), but when his myopia was corrected, could count at 29 to 33 metres. Of two women of the party, one counted correctly at 17 to 22 metres, and the other at 27 to 31 metres. The latter was the daughter of the chief.

In the same year Reich examined a company of 140 Georgians in the Russian army, using Snellen's test, with Russian letters. He examined in the open air. He found normal vision in 164 per cent., \( \frac{4}{4} \) in 47.8 per cent., \( \frac{1}{4} \) in 32.1 per cent., and \( \frac{2}{4} \) in 9.5 per cent.

In 1879 observations were also made in Berlin by Kotelmann on 9 Lappe, 3 Patagonians, 15 Nubians, and 1 Negro. Snellen's Haken were used, probably of the E form. Seven of the Lappe were old enough to be tested had an average acuity of \( \frac{1}{4} \). The highest was \( \frac{1}{4} \). The vision of the three Patagonians was \( \frac{1}{4} \), \( \frac{1}{4} \) and \( \frac{1}{4} \) respectively. The 13 Nubians had an average acuity of \( \frac{1}{4} \), the highest being \( \frac{1}{4} \). The one Negro examined had vision of \( \frac{1}{4} \).

In 1883 Webster Fox examined 250 young American Indians, aged 8 to 22 years. Some had vision of \( \frac{1}{4} \) with Snellen's letter types, but apparently he did not examine for higher degrees of visual acuity. In 1883 Segge1 records observations made by Schott on 6 Chippeway Indians; four had visual acuity of \( \frac{1}{4} \) and the other two of \( \frac{1}{4} \).

In 1888 Kotelmann determined the visual acuity of 17 Kalmucks, 20 Sinhalese, and 3 Hindus. Snellen's Haken were used. The Kalmucks had an average acuity of 27, while one man read No. 6 9 correctly at 42 metres, i.e. visual acuity of 0.7 times the so-called normal, and one woman had visual acuity 3-4 times the normal. The average acuity of the Sinhalese and Hindus was less than that of the Kalmucks, viz. 21, and the highest value obtained was 31.

The observations on the Kalmucks are especially interesting from the fact that

2. J. of real letters at 20 to 29 feet which sustained an angle of 5 minutes at 25 feet.
the visual powers of these people have been very highly extolled by travellers. As long ago as 1776 Falma recorded his astonishment at the way in which Kalmucks could distinguish distant objects on the steppe; on one occasion these people distinguished the dust of a herd of cattle at a distance of about 30 vers (20 miles), when the European commander of the party could see nothing with the aid of a telescope, and similar reports have been given by others who have visited these people.

In 1885 Guppy's recorded observations made on natives of the Solomon Islands by means of the square test dots used in the British army. Twenty-two young adults were tested, the average distance at which the dots could be counted being 57-5 feet and the maximum distance 70 feet. The average for English labourers examined by the same test by the Anthropometrical Committee of the British Association was 521 feet, the maximum, however, reaching 90 feet. Guppy's observations are also recorded in his book *The Solomon Islands and their Nations*, 1887.

In 1888 König examined 4 Zulu in Berlin, either the E or the C type. Three had visual acuity 4 times the normal, and the fourth, a boy, only 1/5.

In 1889 Mac* examined a party of young Niochese men with the army dot test and found that all could count correctly at 37 feet, and some at 68 feet. Only one native was superior to Mac himself.

In 1901 Gilbchevsky examined 142 Oset soldiers (method not stated), and found the average acuity 2/4, while that of other "Cossacks" was 2/5.

In 1902 Johnson in notes on a paper "Bemerkungen über die Maculäse lutea" mentions the cases of two boys from equatorial Africa with vision of 2/3 and 2/4 respectively. The method of testing is not mentioned.

In 1904 Seggel examined 15 Lapps and 4 Hawaiians in Germany by means of Eberhardt's dot test. Of the Lapps 4 had subnormal vision, 3 normal, and 8 were above normal, 3 of these having more than double vision. Of the 4 Hawaiians, three of whom were women, 2 had vision of 2/4, one of 2 and the highest 2/2.

In 1904 also Stehle*, in a paper on colour-blindness, mentions that visual power was normal in 191 Hawaiians and 31 Aleuts and Aleutino-Russian creoles. He does not, however, give any details.

In 1907, K. E. Ranks* recorded observations made on inhabitants of Brazil, by means of squares with one side open. He was only able to examine 5 individuals, 3 of the Bakara and 2 of the Turemi tribe. The vision of the five is represented by the figures 2/2, 2/2, 2/2, 2/2 and 2/2, while Ranks's own vision, after correction of his

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myopia, was $\frac{2}{3}$. Banks had previously been very much astonished at the visual feats of the natives and was surprised to find their visual acuity as low. He records interesting observations showing upon what factors the visual feats depended (see p. 43).

In 1886 several sets of observations were recorded. Cohn 1 examined in Egypt 13 Arabs (7 Bedouin and 6 Bichars); also 100 Egyptian soldiers (recruits) and 64 Egyptian children. Of the 13 Arabs one read No. 6 at 6 metres, four had visual acuity of 11 to 15, three of 15 to 20, four of 21 to 25, while one of the Bedouin read No. 6 at 36 metres, i.e. had a visual acuity 6 times the so-called normal; he was often eight at 40 metres.

Of the 100 Egyptian recruits 75 per cent. had visual acuity from 11 to 20; one had a visual acuity of 45, and one of 50. An English officer examined at the same time read No. 6 at 22 metres, i.e. had acuity of 57 nearly, the same as the third best of the Egyptian soldiers. Seven per cent. had subnormal vision.

Of 42 Egyptian school-boys, of 15 to 20 years of age, no less than 29 per cent. had subnormal vision, while 54 per cent. had acuity of 11 to 20. One boy of 16 read No. 6 at 45 metres, i.e. had acuity eight times the normal.

Of 22 Egyptian girls, five had subnormal vision; twelve vision of 11 to 20. One had visual acuity of 63; this girl had an Egyptian father and a Circassian mother.

In the same paper Cohn records observations made in Bredon on 21 Kalucks in 1897. Three had acuity of 11 to 15, six of 15 to 20, eight of 21 to 25, and three of 26 to 30. With the same illumination, several inhabitants of Bredon had acuity of 15 and that of one man was 22.

In 1884 Pergens 2 also published the results of the examination of 100 Congolese presented at the Brussels Exhibition in 1887. He used Steiger's types, and found that most had visual acuity of two to three times, some four times and one five times the so-called normal.

Observations in Torres Straits and the Fly River.

Four methods were used in my work. The $C$ method was found to be by far the most satisfactory. When I left England I was not aware of Cohn's modifications of this test and I used the ordinary type, known in this country as the test-type for illiterates. A certain number of observations were also made with the ordinary letter test-types of Snellen, chiefly on children. For observations on the method of testing by counting I used Snellen's test No. LIV. A few observations were also made with Gallway's test-types.

The observations by all the methods were made in the open air, either on a verandah in Murray Island and Kiwai, or completely in the open at Mahurin. The verandah at Murray Island was entirely unshaded on one side and one have differed very slightly in illumination from the open. Moreover, as the verandah was only

2 Jena, p. 430. 1886.
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15 metres long. Cases in which the acuity was above 4½ had their examination completed outside. The vernacular at Kiwai was more shaded and it is just possible that the lower illumination may have had some slight influence in producing the lower values for visual acuity in that island.

All the ordinary observations were made with both eyes; in some cases, especially those of subnormal vision, each eye was separately tested in addition. Most of those who have made observations on non-civilized races have adopted this method (Kotzebue being the chief exception), and for ethnological purposes I believe it is the most satisfactory. Many races are so shy of observations of this kind that the additional measure of covering one eye would probably in many cases make all the difference between success and failure. In Murray Island there were individuals who required much persuasion to have their sight tested and with them I have no doubt that covering one eye would have increased the difficulty. If in many races and individuals it is necessary to test both eyes simultaneously, it will be most satisfactory for comparative purposes to do so in all, and there is the further advantage that one is testing vision under the most natural conditions. The chief disadvantage is that one may overlook cases of unilateral defective vision, or even of unilateral blindness. An examination with both eyes simultaneously for comparative purposes, however, does not preclude an additional examination of each eye separately and in nearly all cases in Torres Straits, which presented any unusual features, this was done.

Of the four methods used in Torres Straits the E method gave the most satisfactory results. In most cases the method was understood readily; some men in Murray Island were very slow in learning what to do, and I also had a good deal of difficulty with the girls of that island, which at first led me to think that the girls must be much less intelligent than the boys. Further experience, however, left little doubt that the difficulty was due to shyness rather than stupidity. The natives of Kiwai were also slow in learning the method. The only case in which I failed altogether was that of a native of Kiwai, Emalogo, who seemed unable to understand the method even after he had seen others being tested. The same man, however, failed to understand the method of matching wools for testing colour-blindness. He had come from a neighbouring village for a short time only, and I was unable to repeat the observation as I should have done in Murray Island or Malaita. I also obtained very good results by this method with Australian natives and with young children.

Others who have used this method have also found that it was readily understood. The only exception which I have found recorded was in early observations by Cohn on Nubians, some of whom had difficulty in distinguishing between right and left.

The main features of the method are shown in Fig. 1. The individual to be tested held in his hand a board on which was pasted a large E and when any letter was pointed out to him he simply had to put the E in his hand in the same position. On the back of the board was pasted a mark which indicated to me whether he had placed the E correctly or not.

Observations were always commenced at a distance of 15 metres from the type.

1 Cohn, f. prakt. Anthropol. ii. p. 197. 1879.
This distance had the advantage of being outside that at which most could read No. 5, and I was able at this distance to take them over the large letters of the first four rows till they became perfectly familiar with the method. In many cases the natives had first to be familiarised with the method at close quarters. When they had mastered the method I took them down the board till they reached their limit at 35 metres. In some cases they could read to the bottom, and in those cases I had to increase their distance from the test-type. In most cases they failed at No. 10 or No. 10 or No. 6. I noted their degree of efficiency at 15 metres, and then brought them up to some nearer distance, till I found that at which No. 5 could be read correctly nine times in ten; if twice wrong in ten, they were brought up a metre nearer. If right at this, they were again tried at the further distance. In judging when a given type can be seen, it is necessary to adopt a constant standard of correctness, in order to obtain data from different people and places which are, as far as possible, exactly comparable with one another. Most of those who have recorded observations of this kind do not appear to have adopted any fixed standard, or if so, have not recorded what it was. Coles is an exception, and records that he passed four right answers\(^1\). If I had not adopted a fixed standard, but had gone by

\(^1\) Where there are only 4 possible answers, as in the E test, this standard is probably too low.
general impression, I have no doubt that I should on the whole have obtained higher values than I did. In most cases, however, I found a very sharp dividing line. In many cases a native would at one distance be right every time without hesitation, while a metre farther away five or six mistakes in ten would be made, and this difference would show itself when the observations were repeated two or three times. I cannot speak positively on the question, but I have the impression that the sharpness of the dividing line was more marked than among Europeans.

The observations of two individuals in Murray Island may be given as examples.

Aki, ent. 29, at 15 metres was right with all lines down and including No. 6. Said he could not read No. 5. At 12 metres and at 18 metres read No. 5 easily. At 14 metres was nine times right and once wrong, but corrected the wrong answer when asked. At 13 metres was eight times right and twice wrong, but corrected both wrong answers. He could see only with difficulty and hasten forward in order to see better and was obviously very near his limit which I put down as 3.

Alo, ent. 50, at 15 metres was right with all lines down to and including No. 10. Several wrong answers with No. 8. At 12 metres still made mistakes in No. 6. At 10 metres was right every time with No. 6, but made several mistakes in No. 5. At 8 and 9 metres was right every time with No. 5. Tried again at 10 metres, was right five times and wrong twice, both wrong answers being in horizontal positions of the limbs of the E. At 11 metres he did No. 6 correctly but made several mistakes in No. 5. His limit was put down as 4.

There are several possible sources of error. That of learning by heart has been already mentioned. Although always on the look out for this, I failed to detect one case in Murray Island. In Makunai, on the other hand, where the people have come much more into contact with civilization, and are, on the whole, more intelligent, I met with several cases, and sometimes the bottom line was already known when I began to test, having been learned while I was testing others. I was always able, however, to detect and overcome this difficulty. In the first place it was always No. 5 which was learned, and on going back to No. 6, mistakes would be made in this while No. 5 was done without error. In the second place, if the type were turned upside down, one obtained an entirely new set of letters, and so individual in whom I detected learning by heart was able to read No. 5 in its inverted position. One advantage of beginning well outside the probable limit of vision was to render the danger of learning by heart less frequent.

In other more civilized races, learning by heart would probably be much more common than in Torres Straits, and the modifications used by Cohn should become the recognized ethnological method. It has the further advantage of completeness and portability.

While making these observations other natives were nearly always present; it was impossible to avoid this, and one obvious source of error was that a bystander might sometimes help a friend whose vision was less good than his own. Children were the worst offenders in this respect. This source of error is one which is readily avoided when one is alone to it. It was usually readily detected with the E method. One could often tell at once by the way in which the native turned round the
board in his hands that he was doing in in response to a suggestion, and this was rendered more obvious in Murray Island by the fact that, so far as I could find, they had no very definite words to indicate the four quarters of the E. In Melburi, on the other hand, they had definite words, thus źe was “kadalakiti”, mi, “milukakiti”; E and J were together “bulakiti,” and were distinguished as “paripakiti” (windward) when the open side of the E was towards the wind, and “papakiti” (leeward) when away from the wind.

It is interesting that Cohn1 in Heligoland where the natives, like those of Torres Straits, are all sailors, that instead of answering right or left for different positions of the E they answered north or south, and Cohn found it difficult to get them out of this habit.

The reliability of the E method was shown very conclusively by the results of testing individuals on several occasions. In nearly all cases the results on the different days exactly agreed with one another. In only two cases, both boys, was there a difference of as much as two metres and in each of these cases the first observations had been noted as unsatisfactory. The close agreement of the observations on different occasions may also be regarded as evidence that such changes of the illumination as occur in that climate do not materially affect the visual acuity in the open air.

**Results with the E Method.**

In Murray Island 115 individuals were tested. The average distance at which No. 5 could be correctly deciphered was 10-3 metres, the median distance 11 metres, and the maximum 19 metres.

Of the 115 individuals 67 were men, whose average distance was 9-8 metres and median distance 19 metres. Eleven of these individuals, all old men, had distinctly subnormal vision (less than 3) referable in nearly all cases to pathological causes. If these be excluded, the average acuity of the remaining 58 was 12, the median 4/5, and the maximum 1/5. Thirty-three boys were examined with an average of 4/5, a median of 4, and a maximum of 1/5. Thirteen girls had an average of 12, a median of 4, and a maximum of 4. The individuals tested were not completely representative of the whole male community owing to the fact that many of the younger men were away from the island pearl-diving and could not be tested. Nearly all the older men on the island were tested and their low figures reduce the average considerably, and if the whole male population could have been examined, there is little doubt that the average would have been higher.

In Melburi 35 individuals were tested with an average acuity of 12, and a median result of 4. Of these, 28 were men with an average of 12, and a maximum of 1/5. All of these belonged to the islands of Melburi or Bidal, with the exception

2. i.e., the distance at which No. 5 was correctly deciphered by the individual who was exactly in the middle of the whole series when the results were arranged in order of magnitude.
3. i.e., including all males of and above the age of 17.
of one man from Mos, whose vision was $\frac{4}{5}$. One man, Bugari, had phlyctenular conjunctivitis at the time of examination. His vision was $\frac{4}{5}$, but would probably have been higher if he could have been tested again with his eye in its normal condition. Six boys gave an average of $\frac{11}{5}$ with a maximum of $\frac{13}{5}$. The acuity of one woman tested was $\frac{4}{5}$.

The average acuity is slightly higher than in Murray Island. I believe that this is due mainly to the fact that the individuals tested were more nearly representative of the whole community.

Nineteen individuals were tested who belonged either to the island of Kiwai in the Fly River or to the Mawatta district of the mainland of New Guinea. These natives are closely allied to those of Torres Straits. The average distance at which they recognized No. 5 of the E test was 10.4 metres and the median distance 10 metres. Seventeen of the individuals tested were men with an average of $\frac{4}{5}$ and a maximum of $\frac{8}{5}$, while the figures for two boys, both from Mawatta, were $\frac{4}{5}$ and $\frac{4}{5}$.

The individuals tested were nearly all young men and though there were no cases of subnormal vision, the average was low compared with that of Mabuiag or of Murray Island (when subnormal cases are excluded). This may possibly have been due to the fact that the illumination in which they were examined was somewhat less bright than that of the other localities, but a far more probable explanation is that they were much less familiar with the "white man" than the other natives, understood what they were to do less readily, and took less interest in what they were doing. It was in Kiwai that I met with my only complete failure with the E method. I believe that with a longer stay among them, and with the same spirit of emulation which existed in Torres Straits, their results would have equalled those of Mabuiag.

Taking the ethnographical district of Torres Straits and the Fly River as a whole, 10% of individuals were tested with an average visual acuity of $\frac{4}{5}$, and a median acuity of $\frac{4}{5}$.

These results are set out in another way in Table I, for the purpose of comparison with results obtained elsewhere. All the observations comprised in this table were made by the E method in the open air, i.e., under conditions very closely resembling each other. The most important data for comparison are those collected by Cohn in Egypt and Heligoland. Cohn's Egyptian data are those which are most nearly comparable with mine in having been made by the same method and on a large number of natives in their own country, but they differ from mine in that they were not made on natives representative of a whole community, but only on school-children and young army recruits. The figures in the first column give the number of individuals examined in each group; those in the second column, the average acuity according to the formula $\frac{10 \times e}{D}$, some of the groups having been finally tested with No. 6 or No. 6 5 types instead of with No. 5 as in my own observations. The figures in the succeeding columns give the percentage number of individuals who recognized the types at different distances. The first column gives those who saw No. 5 at 5 metres or less, No. 6 at 6 metres or less, and No. 6 5 at 6 5 metres or less. The next
column includes those who saw No. 5 at 6 to 10 metres, No. 6 at 7 to 12 metres, and No. 6.5 at 7 to 23 metres, and so on. The final column gives the percentage of those whose vision exceeded what is often supposed to be the normal European standard.

The chief differences between the different Papuan groups have already been considered. The most striking difference shown by this table is in the column for subnormal vision, the large proportion in Murray Island being explained by the large number of old men tested on this island while the absence of subnormal cases in Kiwai may have been due to the fact that all those examined were young or middle-aged.

Table I.

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>Average age</th>
<th>F=1 or &lt;1</th>
<th>F=1 to 2</th>
<th>F=2 to 4</th>
<th>F=4 to 8</th>
<th>F=8 to 16</th>
<th>F=16 to 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray Island</td>
<td>115</td>
<td>102 5 112</td>
<td>35-7</td>
<td>48-7</td>
<td>43</td>
<td>0</td>
<td>0</td>
<td>90-7</td>
</tr>
<tr>
<td>Maloing</td>
<td>36</td>
<td>116 5 56</td>
<td>22-2</td>
<td>69-4</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>94-4</td>
</tr>
<tr>
<td>Kiwai</td>
<td>19</td>
<td>102 5 0</td>
<td>68-3</td>
<td>36-0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Torres Straits and Fly River</td>
<td>170</td>
<td>106 5 58</td>
<td>35-9</td>
<td>51-8</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>85-2</td>
</tr>
</tbody>
</table>
| Kalmucks (K éxito- 
| | 35 | 14 5 0 | 20-4 | 65-2 | 44 | 0 | 0 | 100 |
| Stahlhaut-Hindus (Kölesehov) | 12 | 126 6 77 | 53-8 | 20 8 | 0 | 77 | 0 | 92-5 |
| Afghan (Coho) | 164 | 32 4 679 | 78 | 18 | 12 | 12 | 78-6 |
| Highland men (Coho) | 100 | 106 6 149 | 560 | 366 | 0 | 0 | 0 | 86-0 |
| German navy | 100 | 128 6 110 | 480 | 424 | 0 | 0 | 0 | 88-9 |
| German Artillery (Saxa and Segal) | 126 | 52 | 570 | 209 | 65 | 3 | 0 | 94-7 |
men. It is, however, quite possible that the pathological changes which so largely affected the vision of the old men in Murray Island would have been found to be present in Kiwi if more extended observations could have been made. It will be seen from the table that more than two-thirds of the Malagasy Islanders had vision between 2 and 3 times what is commonly supposed to be normal European vision. The second part of the table shows observations made on non-European races. I have only included those which have been made by the same method as that employed in Torres Straits and on a sufficient number of individuals to give some idea of the average acuity. It will be seen that the figures for the Kalmucks and for the Sinhalese and Hindus show a fairly close agreement with those of Torres Straits, except that among the Kalmucks there were three cases of marked hyperacuity exceeding anything observed in Torres Straits. On the other hand, cases of subnormal vision were almost absent, but this is readily explained by the fact that in both cases the observations were made on parties of natives brought to Europe for exhibition purposes. These natives were young and probably healthy, the oldest of the Kalmucks examined by Ketelmann being only 35, while the ages of the Sinhalese and Hindus ranged from 12 to 45. There is little doubt that these groups were not representative of their communities and probably gave higher average results on this account.

The few Arabs examined by Cohn gave an average agreeing almost exactly with that of Malagasy. These observations, though few in number, are more satisfactory than the preceding in that they were men taken at random in their own country. They varied in age from 12 to 50, the only man of the latter age having vision \( \frac{5}{3} \). The vision of one of the Bedouin was \( \frac{5}{3} \), and this man was often right at 40 metres.

Cohn’s Egyptian statistics are unsatisfactory for comparative purposes in that they are derived only from observations on children and on army recruits all under 25 years of age. In spite of this, they show distinctly lower average visual acuity and a higher proportion of cases of subnormal vision than the inhabitants of Torres Straits. The observations made on army recruits are open to the further objection that some cases of distinctly subnormal vision may have been excluded. On the other hand Cohn found a few cases of very hyperacute vision, including one boy with vision eight times the so-called normal.

The data for European vision made by the E method in the open air, comparable with those which have been considered, are not very abundant. The most satisfactory are those obtained by Cohn\(^1\) from 100 inhabitants of the island of Heligoland. These were all adult males, varying in age from 20 to 84, so that they may be taken as representative of the whole community. The inhabitants of this isolated European island probably furnish a very satisfactory group for comparison with the natives of Murray Island. It will be seen that the general average acuity is distinctly less than that of Murray Island, though not so to any marked extent. On the other hand the general acuity of the Heligolanders is superior to that of the Egyptians examined by Cohn, though there were no cases of marked hyperacuity such as were found among the latter.

\(^1\) Deutsch. med. Wochenschr. xxii. S. 418. 1896.
Visual Acuity.

Cohn\(^1\) also examined in 1873 and 1874 a number of the inhabitants of Schr"oberen, a village in the hills not far from Breslau. Unfortunately he limited his observations to children and to people of over 60 years of age, and consequently his figures are not representative of the whole community. The children, also, were examined with the C form of Schede's Baken, which may be recognized at a greater distance than the E form. On these accounts I have not included these results in the comparative table. Of 100 old people, 12 had vision of \(\tfrac{1}{3}\) or less, 87 had vision ranging from \(\tfrac{1}{3}\) to \(\tfrac{1}{9}\) while one had still higher visual acuity. Of 244 children's eyes (122 individuals) examined, only seven had vision of \(\tfrac{1}{5}\) or less, 123 had vision ranging from \(\tfrac{2}{3}\) to \(\tfrac{1}{9}\) and 114 had vision ranging from \(\tfrac{1}{3}\) to \(\tfrac{1}{9}\). In Murray Island among 46 children, tested by a slightly more difficult method, there was no case of subnormal vision, 15 had vision ranging from \(\tfrac{1}{3}\) to \(\tfrac{1}{9}\), 50 from \(\tfrac{1}{3}\) to \(\tfrac{1}{9}\), and one had still more acute vision, so that the vision of the Schr"oberen children seems to have been distinctly inferior to that of the Papuans.

In 1888 Schadow\(^2\) examined 146 children on the East Frisian island of Borkum. Unfortunately he carried out his investigations in a room and used the C type only for the younger children, and Schede's letters for the older children. His results therefore are far from comparable with those already given. He found vision of \(\tfrac{3}{4}\) in 91.8 per cent, but did not test for higher degrees of visual acuity.

Most extensive observations have been made with the E method in the open air in the German army and navy by Cohn\(^3\), Soitz, and Seggel\(^4\), which appear to be exactly comparable with those given in the tables so far as method is concerned. From the ethnographical point of view, however, these observations are unsatisfactory in that they are made on selected members of the population. To show how far these figures must depart from a true representation of the whole community, I may mention that Seggel\(^4\) found no less than 0.14 per cent, of volunteers and candidates for the German army had subnormal vision, while Seggel's figures given in the table show only 0.2 per cent, of cases of normal and subnormal vision. The results for the army are, however, very interesting in that they show the existence of considerable degrees of hyperacuity among Europeans and I have therefore included them in the table. It will be seen that the figures compare very favourably with those of Torres Strait and that cases of considerable hyperacuity are in a larger proportion. They show that if cases of subnormal vision are excluded there is no marked difference between the visual acuity of the average European and the Torres Strait Islander.

In the account of his observations in Egypt, Cohn\(^5\) gives two tables comparing civilized with uncivilized vision (Naturvölker with Cultiviraller), and has from these tables drawn the conclusion that there is no essential difference between the two groups.

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1. Arch. f. optik, Bd. xxi, 2. S. 350, 1873. See also the paper on the observations in Egypt.
These tables are, however, open to very serious objections. Among the "Naturvolker," comprising only 238 individuals, Cohn has included the 100 Heligolanders, while the remaining 138 are made up of a number of small groups, the largest comprising 21 individuals, and some of these groups were examined by different methods.

The table of civilized people which Cohn gives for comparison contains the results for 2620 individuals, nearly all examined by the E method. Among these, however, Cohn includes his 164 Egyptians and also 140 Georgians, of whom Reich distinctly states in his paper that they were essentially "Naturleute." Further the 2620 individuals include no less than 2212 men either in the army or navy of Germany, and therefore a selected group from which cases of subnormal vision would have been excluded.

So far as present investigations have gone, the only results for European populations which are at all strictly comparable with my results are those obtained by Cohn in Heligoland. If the figures for the two groups are compared, it will be seen that the Heligolanders are distinctly inferior to the Fajmuns, the averages being as 1.77 : 2.12 and more than half the former have vision less than twice the so-called European normal, while more than half the latter have vision between two and three times the same standard. The difference, however, is not great and seems to show that European islanders living an outdoor, seafaring life do not differ very greatly in visual acuity from Fajman islanders whose life is also largely spent upon the sea.

**Influence of Sex.**

It would be very interesting to know whether there is any marked difference between the sexes in a savage community in respect of visual acuity, but unfortunately I can contribute little to this problem as very few women were tested in Torres Straits. In Murray Island 3 girls, ranging from 10 to 17 years of age, were tested, their average visual acuity being 5/6. This is slightly above the average for 30 boys of Murray Island, viz 5/7. No case of subnormal vision was found and the maximum was 5/4. There was certainly less variation than among the boys, but the numbers were not sufficient to allow one to speak very definitely on this point. The only woman tested in Maluku had acuity of 5/6. The scanty data, so far as they go, tend to show that there was no marked difference between the sexes in Torres Straits.

Kotelmann's observations point in the same direction. Among the Sinhalese and Hindus tested by him 15 were male and 5 female. The average acuity of the former was 5/4, of the latter 5/6. Of the Kalaneks tested by Kotelmann 8 were male and 8 female. The average acuity of the former was 5/4, of the latter 5/4 and one woman had visual acuity of 5/4 or more than five times the so-called normal.

Among the Egyptians examined by Cohn 22 were girls. Cohn does not give the individual observations or the average, but 12 out of the 22 had vision between 1/1 and 2/0. Three were between 2/1 and 2/5, while two others had vision of 4/5 and 4/6 respectively.
Among the Congolese examined by Fergus, on the other hand, the men were distinctly superior; 40 men had an average acuity of 2/62, while the average for 10 women was 2/6.

Further observations on this question are needed. The facts, so far as they go at present, seem to show that in a state of nature there is no marked sexual difference in visual acuity.

**Influence of Age**

The relation between visual acuity and age is shown in Table II.

The numbers given in column A give the number of individuals of each age examined. Those in column B give the average number of metres at which No. 5 was recognized. In Murray Island, column C represents the results when any defect of refraction had been corrected (Cohn's Sekshinys in the strict sense). Owing to

<table>
<thead>
<tr>
<th></th>
<th>Murray Island</th>
<th>Malting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>above 55</td>
<td>5</td>
<td>46</td>
</tr>
<tr>
<td>50-65</td>
<td>6</td>
<td>81</td>
</tr>
<tr>
<td>65-70</td>
<td>7</td>
<td>73</td>
</tr>
<tr>
<td>70-75</td>
<td>8</td>
<td>77</td>
</tr>
<tr>
<td>75-80</td>
<td>10</td>
<td>99</td>
</tr>
<tr>
<td>80-85</td>
<td>9</td>
<td>136</td>
</tr>
<tr>
<td>85-90</td>
<td>8</td>
<td>119</td>
</tr>
<tr>
<td>90-95</td>
<td>5</td>
<td>120</td>
</tr>
<tr>
<td>95-100</td>
<td>7</td>
<td>121</td>
</tr>
<tr>
<td>boys under 15</td>
<td>32</td>
<td>118</td>
</tr>
<tr>
<td>girls</td>
<td>13</td>
<td>114</td>
</tr>
</tbody>
</table>
the rarity of errors of refraction, it will be noted that there is very little difference between the figures in the columns B and C.

Column D gives approximately the number of individuals of each age whom I failed to examine in Murray Island. The figures in this column show very clearly that the younger men were less fully represented than their elders (owing to their being away pearl diving) and, as already mentioned, the figures for visual acuity for this island are certainly lower than they would have been if the whole community had been examined.

The figures for both Murray Island and Mabbing show a very distinct and progressive decrease of visual acuity from the age of 35 onwards. The agreement between the results for the two islands compensates in some measure for the small number of individuals of each age examined.

Among Europeans the decline in visual acuity is said to begin about the age of 50. The fact that it begins at an earlier age in Torres Straits is probably due to definite pathological changes, especially in the lens and cornea (see p. 10).

**Fatigue and Practice**

In testing Europeans, especially in a bright light, it sometimes happens when near the limit of vision that the first three or four letters are recognized correctly, and then mistakes are made and the person tested may say that he is unable to see the letters any longer. This may only be due to glare in a bright light but in some cases it has seemed as if the mistakes were caused by some alteration of accommodation. This rapid change occurred very rarely in Torres Straits. When testing some Australian natives in Mabbing, it seemed more marked, but I was unable to make up my mind whether it was not due merely to rapid falling off in interest.

The influence of practice is of more importance. We have at present no data to enable us to say whether the power of recognizing letters or the position of an E is influenced by long-continued practice. Very little experience with the E method is however sufficient to show that there may be a rapid improvement by practice. It has occurred to me over and over again that an individual has been unable to recognize the position of the E, say at 10 metres, but after trying at a nearer distance and then returning to 10 metres he has been right every time and may even have been able to give correct answers at 11 or 12 metres. This rapid improvement by practice is more common among Europeans than I found it to be in Torres Straits. From the results of my own experience when being tested by the method, and this has been confirmed by others, I believe the explanation to be that one can recognize the position of the E when it is merely a hurred spot if one notices that one side is slightly less definite than the others. I had previously met with cases in which individuals were right every time although they said that their answers were pure guesses. There can be little doubt that their correct guesses were due to the sensory indication afforded by the smaller degree of definition of the open side of the E, although they were not clearly conscious of the indication.

The fact that the position of the letter can be recognized correctly when it is
merely a blurred spot has important bearings on the value of the method. In the first place, it shows that one must be very careful in drawing conclusions from this method as to the minimum visual angle. Cohn has stated that the Egyptian boy, whose visual acuity was $4^\circ$, distinguished at a visual angle of $7^\circ$, but since his success almost certainly depended on recognition of the kind described above, and since the whole letter subtended an angle of $5^\circ$, one cannot say that his visual angle was smaller than $37^\circ$. Conclusions as to the minimum visual angle from any of the customary methods of testing visual acuity can in any case only be rough approximations owing to the psychological factors involved in these methods.

In the second place, an element of uncertainty is introduced into the comparison of the results of different individuals and races. Two individuals with the same visual acuity may give different results with the E method owing to the fact that one may only recognize the positions of the letters when he sees them distinctly, while another may make use of the indication above-mentioned. I have already said that the natives of Torres Straits did not show the rapid improvement while being tested as commonly as do Europeans. This may mean that they failed to make use of this indication and only recognized the position of the E when they saw it distinctly or they may, with their quick observation, have noticed the difference in the blurred E at once. Unfortunately in the case of such people, one is unable to discover upon what sensory basis their answers depend. If the former supposition is correct, the method, as a means of testing visual acuity in the strict sense, would give too low values for such people, as compared with Europeans.

The fact that the position of a letter can be recognized when only a blurred spot in a distinct disadvantage of the E method, but this disadvantage may be very much lessened by using an E in which the middle limb has been prolonged so that it is of the same length as the upper and lower limbs, and I am now making observations to compare the results with the two forms of the letter.

**OTHER METHODS OF TESTING VISUAL ACUITY.**

In addition to the E method, others were tried on beginning work in Murray Island. The great advantage of the E method soon became so obvious that the other methods were discontinued. These methods, however, brought out some points of interest which may be briefly considered.

Twenty-two natives of Murray Island (chiefly children) were examined with the ordinary letter test-types of Snellen. The general method was exactly the same as with the E method, observations being commenced at 15 metres, and then at nearer distances till No. 3 could be read correctly.

The method was unsatisfactory for two reasons: in the first place, mistakes were obviously made owing to unfamiliarity with the letters. Some children made occasional mistakes in some letters even when quite close to them, and this lack of familiarity is sufficient to prevent any satisfactory comparison of their results with those of the average European child. In the second place, the method is radically defective as a scientific method of testing visual acuity (however useful it may be as a practical clinical
method) in that different letters differ greatly in the ease with which they can be recognized. It is consequently impossible to adopt any definite standard. Thus to give one instance, a fairly intelligent boy in Murray Island made four mistakes in No. 5 at 15 metres, three mistakes at both 14 and 13 metres; only one mistake at 12 metres but was unable to correct this mistake till 8 metres from the type. A more intelligent boy at 10 metres and at 9 metres made four mistakes; at 8 metres two mistakes and at 7 metres all were right. If one required every letter to be recognized, the

<table>
<thead>
<tr>
<th>Name (Tas)</th>
<th>Age</th>
<th>E</th>
<th>Letters</th>
<th>Name (Tas)</th>
<th>Age</th>
<th>E</th>
<th>Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul.......</td>
<td>42</td>
<td>12</td>
<td>5</td>
<td>William (Tas)</td>
<td>11½</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Charlie (Pas)</td>
<td>17</td>
<td>8</td>
<td>between 3 and 7</td>
<td>Abus ..........</td>
<td>11</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Sailor .......</td>
<td>11½</td>
<td>11</td>
<td>10 9</td>
<td>Jasons .........</td>
<td>13</td>
<td>13</td>
<td>11 9 8</td>
</tr>
<tr>
<td>Captain .......</td>
<td>11½</td>
<td>14</td>
<td>11 10</td>
<td>Pete (Pas) .........</td>
<td>13</td>
<td>12</td>
<td>11 9 8</td>
</tr>
<tr>
<td>Sam ...........</td>
<td>15</td>
<td>13</td>
<td>11 10</td>
<td>Depress .........</td>
<td>10</td>
<td>11</td>
<td>8 7</td>
</tr>
<tr>
<td>Apert ........</td>
<td>14</td>
<td>9</td>
<td>7 6</td>
<td>Loko .........</td>
<td>9</td>
<td>8</td>
<td>7 6 4</td>
</tr>
<tr>
<td>Jimmy Hoo 12½</td>
<td>18</td>
<td>14 12</td>
<td>8</td>
<td>Harry .........</td>
<td>10½</td>
<td>14</td>
<td>10 8</td>
</tr>
<tr>
<td>George (Pas)</td>
<td>11</td>
<td>6</td>
<td>4</td>
<td>Sunmi .........</td>
<td>10</td>
<td>13</td>
<td>10 8 7</td>
</tr>
<tr>
<td>Jacob (Gat)</td>
<td>15</td>
<td>12</td>
<td>10 8 7</td>
<td>Aki .........</td>
<td>10½</td>
<td>7</td>
<td>6 3</td>
</tr>
<tr>
<td>Merbour......</td>
<td>11</td>
<td>11</td>
<td>9 7</td>
<td>Godson .........</td>
<td>13</td>
<td>14</td>
<td>11 9</td>
</tr>
<tr>
<td>Tom (Tasni)</td>
<td>11½</td>
<td>10</td>
<td>9 7</td>
<td>Maletta (Jami)</td>
<td>13½</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>

Acuteness of those boys would have been put down as ½ and ¾ respectively, although by the E method it was 4 and 4. The letter test would have wholly failed to show the great difference between them. In Table III, are given the results for the letter as compared with the E method. The figures given in the first of the three columns for the letter method show the distances in metres at which three or four mistakes were made, the second column those at which one or two mistakes were made, and the third
column the distances at which all were read correctly. The unsatisfactory nature of
the method will be at once apparent.

One fact which comes out very clearly, however, is that the distance at which
letters could be read, even with a liberal allowance of mistakes, is much less than
that at which the position of an E could be recognized.

THE COUNTING METHOD.

Another method which I tried in Murray Island was Snell's Table LV, which
seemed to me the most satisfactory of the methods which depend on counting. I
used it under exactly the same conditions as the other tests, beginning observations
at a distance of 15 metres. In this test the white dots may be exposed through a
hole in a screen in numbers varying from 2 to 7. One fact soon became obvious,
viz. the results for visual acuity if tested with groups of 2, 3 and 4 dots would give
very different values to those with groups of 5, 6 and 7 dots, the difference in distance
for the two sets of numbers being in some cases as much as 5 or 6 metres; thus Ulaia,
tested on two occasions, counted the groups of 2, 3 and 4 dots at 15 metres, while
he was only doubtfully correct with the large groups at 8 metres. The same difference
was present in the case of the boys, although they were taught arithmetic; thus
Captain, aged 12, counted 2, 3 and 4 at 14 metres, and 5, 6 and 7 only at 8 metres.
I only examined 10 individuals as the method seemed to me entirely worthless for
the people in question. In Murray Island the power of counting is very poorly
developed; in their own language they have individual words only for 1 (gece) and
2 (niti). By compounding these (nece-gece, nece-niti, nece-nece-gece, and nece-nece-niti)
they obtained numerals up to 6, and beyond this they resorted to special methods of
counting by the fingers and joints. At the present time they chiefly use English
numerals. For such people, it is not surprising that a method of testing visual acuity
which involves counting should prove to be unsatisfactory; but there are many other
uses in which the power of counting is also very little developed, and in devising
methods for ethnological purposes, it is of supreme importance that they should be
capable of universal application.

A method in which the numbers to be counted should be limited to one and
two was suggested by Mr. Galton in a discussion at the Anthropological Institute in
1885, but this would involve a serious difficulty. Two dots close to one another would
be seen at a certain distance as one linear object and only as two dots at a greater
distance, and the results might be misleading. One individual would only say he saw
two points when he distinctly discriminated the points, while another sharper individual
might answer two as soon as he saw a linear instead of a punctiform object. I have
tried this form of the test myself, and found that I could give correct answers for
one and two dots (using Snell's test-type) at a distance at which I was wholly
unable to distinguish the two dots. The same difficulty is met with in observations
on the discrimination of two points touching the skin; many individuals notice after
a little practice that two points below the threshold often produce the same sensation
H. II.
as a linear or oval object, and they distinguish one from two points by this means although they do not distinctly experience two separate sensations. Among savage and half-civilized peoples it is impossible to discover upon what sensory basis a judgment depends and any opening for equivocal results of the kind should be avoided. As we have already seen, even the simple $E$ method used in Torres Straits is not wholly free from this objection.

**Guillier's method.**

From the physiological point of view the most satisfactory method of testing visual acuity is that proposed by Guillier. In it psychological factors are reduced to a minimum and any opening for the kind of equivocal result just considered is entirely done away with. This method depends on the visibility of a black dot on a white ground; the distance is found at which a black dot of a certain size situated in a square space is no longer distinguished from the ground. There are two theoretical objections to it; one is that if visual acuteness is defined by the angle at which two points can be distinguished, this method does not measure visual acuteness in the strict sense. The other objection is that the power of distinguishing one object depends so greatly on its luminosity. We see a star although the visual angle which it subtends must be infinitely small. This objection is, however, of more theoretical than practical importance. Under all ordinary circumstances the visibility of a black dot on a white ground is not more affected by illumination than is that of other objects used for testing visual acuteness.

I had a set of Guillier's test-types with me and used them in a few cases with satisfactory results, but was unable to use them in any large number of cases owing to two disadvantages in the present form of the types. In the first place the two rows of No. 5 were so close to one another that there was occasionally doubt as to the square which was being indicated. In the second place the dots are placed either in the middle or in one corner of each square, and the individual under examination is required to give the position of the dot. There was only one blank square in each row. It is obvious that this method would lead to difficulties in respect of language and the only method which I found practicable was to give the native an empty square in which he had to mark a dot in the same situation as occupied by that in the square to which I was pointing. This method was necessarily laborious and I only made sufficient observations to satisfy myself that the method would be satisfactory if modified for ethnological purposes. This might be done on the same lines as those on which Cohn has modified the $E$ test, either by having a large number of squares at some distance from one another with a large proportion of blank squares interspersed among the others, or by exposing squares with and without dots through an aperture.

The power of distinguishing stars might be a useful test of visual acuteness in the absence of other objective tests. *Extraordinary instances of powers of discrimina-

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1 *Arch. f. Anthropologie*, Bd. xxvii. S. 381. 1891.
then have been recorded in Europeans; thus Humboldt records the case of a man who could see with the naked eye the satellites of Jupiter, and other similar cases are said to have occurred. There was no doubt that the natives of Torres Straits could distinguish stars of low magnitude well. Several men made for me drawings of constellations (i.e. their own constellations), but these were obviously to a great extent conventional and could not be regarded as evidence of what they really saw. Two men who made drawings of the Pleiades agreed in giving eleven stars grouped in very much the same way, but their drawings were almost certainly conventional. The subject is worthy of further investigation, and drawings of various constellations made by members of different races might illustrate their powers of vision, although the differences of distinctness owing to atmospheric conditions would prevent any exact comparison. The Pleiades are especially useful in this respect owing to the interest which this group excites among so many savage races. The star "Acor" in the tail of the Great Bear (of the 5th magnitude but obscured by its close proximity to Minar) is said by Humboldt to have been used by Arab and Persian astronomers as a test of visual discrimination.

Abnormal Refraction of the Eye.

Most of the natives who were found to have low visual acuity were tested for errors of refraction. In testing with glasses each eye was examined separately, but otherwise the conditions were the same as in the ordinary determination of visual acuity. The process was in most cases very tedious, and usually more than one day was necessary. The natives did not like being tested. They were always interested in anything in which they excelled, but disliked having their inferiority in any respect shown, and consequently I had more difficulty with this than with any other of my observations. Unfortunately it was not possible to determine the refraction by means of the ophthalmoscope or by retinoscopy.

Hypermetropia.

Slight degrees of hypermetropia have been described as the normal condition of the child and of the savage. Cobb found that 77 per cent. of the 340 children of the village of Schullinaben showed manifest or facultative hypermetropia, while after the instillation of atropin, every child was found to be hypermetropic.

Similarly Callan found 67 per cent. of the Negro children examined by him to have facultative hypermetropia. Nearly all the Lapps, Patagonians, Yahuan and Kalmucks tested by Kottmeier, 5 were hypermetropic in one or both eyes, 60 amounts varying from 23 to 200 P.; of the 23 Siuhbros and Hindus, 13 were hypermetropic, the amount varying from 25 to 75 P. Schütz found six Chippewy Indians to have slight hypermetropia.

1 Environ, 1690, vol. ii. B. 312.
2 Arch. f. Ophthalm. BE. XVIII. AMH. ii. B. 405. 1071.
3 loc. cit.
4 loc. cit.
5 loc. cit.
6 loc. cit.
7—2
Abbeleford* found that some Kirghises and Togo Negroes examined by him had slight hypermetropia.

Pergen* notes that two of his Congolese had at least one diopter of hypermetropia.

High degrees of hypermetropia, on the other hand, have not been recorded except in one Lapp woman examined by Seggel.

Of the cases of subnormal vision examined by me in Murray Island none were hypermetropic; all had distinctly worse vision with convex glasses.

I tested several of those who had the most acute vision without any decided result. When placed at their limit of vision some saw distinctly worse with a + 1.0 lens, while to several +1.0 made no appreciable difference, and when the natives were placed slightly outside their limit there was no obvious difference in the number of letters recognized correctly with and without a convex glass. Unfortunately I had not with me a convex glass of less than one diopter, and the fact that the vision of some was certainly not diminished, renders it probable that slight degrees of hypermetropia existed in Murray Island.

Myopia.

Myopia appears to be very rare among savage peoples. As long ago as 1843, Farnari* noted that it was almost unknown among the Kabyle and other races of Algeria. Cohn* found that of the 17 Nubians examined by him in 1879 one was myopic—being the only member of the party who could read Arabic. Ketelmann, Seggel and Pergen* found no case among the Kumeus, Sinhalose, Hindos, Lapp* and Congolese examined by them. Abbeleford* found one Javanese myope to the extent of one diopter. Guppy* found that one of his Solomon Islanders was probably myopic.

In school children belonging to various races, myopia appears to be more frequent. Callan* found myopia in 20 per cent. of the Negro school children he tested. Webster Fox found it in 25 per cent. of his American Indian children. Roberts* examined 6183 school children in Buenos Aires and found 4.3 per cent. myopic.

In Mexico Rama* found that of the children attending the superior schools who were mostly of European parentage 19 per cent. were myopic, while only 4.4 per cent. of the half-castos and 3 per cent. of the children of the indigenous inhabitants had this defect.

Among the Japanese, myopia appears to be very common. Stephensons* quotes results obtained by Berry by examining 1410 men of Kio in a week of whose 33.2 per cent. were myopic. Stephensons also gives reports from the public school reports of Yokohama,

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1 Ellis, Monatsh. f. AugenhHeilk., xxvii. S. 333. 1890. 2 loc. cit.
3 loc. cit. Seggel also examined 8 Fingoes with the ophtalmoscope; all had normal refraction, but one had an atrophic crescent which is usually associated with myopia. He also records that Schöttl found the same condition in one of his Chipewyan Indians, who was also astigmatism.
4 loc. cit. 5 loc. cit. 6 loc. cit. 7 loc. cit. 8 Quoted from Cohn.
showing 5-4 per cent. of myopia. Reich found that myopia was as common among Armenian and Georgian children as among Ruszczak.

Several men and boys in Murray Island were improved by concave glasses.

Greggy, age 35—40.
R. eye $V = \frac{2}{3}$.
L. eye $V = \frac{2}{3}$.

Kumberti, age 50—55.
R. eye $V = \frac{1}{2}$.
L. eye $V = \frac{2}{3}$.

Cooma, age 45—50.
R. eye $V = \frac{3}{4}$.

Saia (Coeur?), age 45—50.
R. eye $V = \frac{1}{3}$.

For right eye, see p. 39.

George (Pudi), age 11.
R. eye $V = \frac{3}{4}$.
L. eye $V = \frac{2}{3}$.

Charlie (Also), age 11.
R. eye $V = \frac{3}{4}$.
L. eye $V = \frac{2}{3}$.

This boy had a distinctly myopic appearance and had been especially noticed by Mr Bruce, as having defective eyesight.

Aki, age 10.
$V = \frac{2}{3}$, improved slightly by $-1.0$d.

Two young men, Mehi and Loko, had vision with the E test which must be regarded as subnormal, viz. $\frac{1}{3}$ and $\frac{2}{3}$, but unfortunately I was not able to test them with glasses. I have little doubt that they were myopic or astigmatic. One boy, German, a younger brother of Mehi, has vision of $\frac{2}{3}$, but I was also unable to test him with glasses.

In some of the above cases the improvement by a concave glass was very slight, but in each case there was no doubt that they read better with than without the glass. There were other men whom I tested with glasses without bringing about any improvement, but the observations were difficult and often unsatisfactory, and I therefore refrain from giving the percentage of myopia in Murray Island. The condition certainly existed, but only in slight degrees and in a few individuals.

Arch. f. Ophthalmol. Bd. xiv, Abh. Nr. 2. 221. 1874
V. Astigmatism.

Very few cases of astigmatism have been recorded: Calhan 6 found 5 cases in 456 children. Romay 6 found 3.2 per cent among the children attending the superior schools in Mexico, 5 per cent. among half-caste children, and no case among 380 indigenous children. Suggel 6 found hypermetropic astigmatism in one Lapp girl.

Oliver 6 states "astigmatism of no mean degree" has been found among American Indians, but unfortunately he gives no reference and I have been unable to find upon what evidence his statement depends. Of 250 Indian children examined by Webster 7 only 3 were astigmatic.

Abedelhoff 6 examined 35 Kirghises and 10 Negroes from Topoland with the ophthalmascope and found twenty of the former and three of the latter free from corneal astigmatism. In the astigmatic cases, the vertical meridian was the more convex, as is most frequently the case among Europeans.

Several cases of astigmatism were discovered in Murray Island. One of the many advantages of the E method is that it often enables one to detect the presence of astigmatism. In many cases I found that w or m were recognized at a greater distance than E and g, and vice versa, and some of these on examination with glasses were found to have measurable astigmatism. In other cases the differences in the correctness for the two directions were slight, and I think it probable that in these the answers indicated a slight degree of astigmatism which I could not improve by means of glasses.

One point of interest is that a measurable amount of astigmatism may exist with power of vision above the normal; thus, Charlie Paul, nat. 17, read no. 5 E at 8 metres, while at 9 metres he gave wrong answers in the vertical positions only. I tried him with glasses, and with +1.50 c. ax. vert., he was right every time at 11 metres. The only other simple case was one of myopic astigmatism, viz., our servant Debe Wali, nat. 35—40, whom I tested on various occasions, when he varied between +1 and +1.50; with +2.00 c. ax. vert., his vision was +1 and very nearly +1.50.

Three men were improved by combining spherical and cylindrical glasses. Barn, a good observer, nat. 35—40, could only read no. 5 E at 4 metres; with the left eye alone he made mistakes at this distance. With +2.00 s.p.h. he recognized w and m at 7 metres, but made mistakes in the horizontal positions; with +2.00 s.p.h. +1.50 c. ax. vert. his vision became almost +1 with each eye. On testing again without glasses he could not recognize no. 5 correctly at 4 metres.

Another man, who probably had compound myopic astigmatism was Magi, nat. 40—45. His unaided vision with each eye was only +1.50. With +2.00 s.p.h. he could read E and g of no. 5 correctly, but not w and m. With +2.00 s.p.h. +1.50 c. ax. vert., his vision was +1 with the right eye, and almost +1 with the left eye.

Sixt, nat. 45—50, was more doubtful. His left eye was probably myopic and

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1 See, etc. 2 See, etc. 3 See, etc. 4 Nettles and Oliver's System of Diseases of the Eye, vol. iv. p. 140. 1000. 5 Philadelphia Med. Times, vol. 34, p. 345. 1845. 6 Kurr. Monatsh. f. Augenheilk. xxvii. S. 339. 1890.
has already been mentioned. With his right eye his vision was ½, mistakes being made chiefly in the verticals. With -2 n. sph. F = ½ nearly, the verticals being again mostly wrong. With -1 n. sph. c - 1 n. cyl. ax. vert. F = §. On his left cornea there was a distinct nebula, partly obscuring the pupil and there was probably slight change of the same kind on his right cornea. The improvement by glasses was less definite than in most other cases, and taking into account his corneal condition, one is hardly justified in saying positively that his refraction was abnormal.

It is known that pterygium sometimes affects visual acuity by distorting the corneas, but this did not appear to have happened in any case in Torres Straits. The four men in whom the condition was most marked, viz. Papi and Billy Gass of Murray Island, and Gini and Wane of Mabuiag, had visual acuity of §, ⅔, ⅔ and ⅔ respectively.

VISUAL ACUITY IN POOR ILLUMINATION.

In his book on the Solomon Islands Guppy notes that the natives of those islands did not appear to experience the temporary arrangement of vision on passing into their dark houses which occurs with Europeans. In other words he believed that their eyes became adapted to darkness more rapidly than that of the European.

It is obvious that observations of this kind may be misleading. The familiar fact that the sensitiveness of the eye to light increases greatly on staying in the dark or in low illumination for some time, and the nature and amount of this increase has been carefully studied in the European eye. The condition of increased sensitiveness is known as dark-adaptation. One has to distinguish between several problems: (i) the determination of the threshold for light, i.e. the smallest amount of light which can be seen at all; (ii) the determination of the threshold for form, i.e. the smallest amount of illumination which enables the form of an object, such as a letter, to be recognized; (iii) the determination of the rapidity with which the dark-adaptation takes place which enables one to see light or form in a given feeble illumination. It has been stated that some were seen better in the dark than Europeans, i.e. their thresholds for light or form are lower. It was, however, with the third of the above problems that Guppy's observations were concerned and it was this problem that I endeavoured to investigate. I endeavoured to determine the time which elapsed from the time the head was put into a dark chamber to the time when a letter or group of letters within the chamber were recognized. The letters used were cut out of No. 5 Snellen's test-types and pasted on a small square of white paper. I used a portable dark chamber which we had with us for photographic purposes and I placed the letters on the floor of this. The chamber was not sufficiently dark and I had therefore to cover part of it with a blanket. The chief factor which prevented the observations from being satisfactory was change in the external illumination (daylight). The observations were made on three boys, Aperi, James,
ANTHROPOLOGICAL EXPEDITION TO TORRES STRAITS.

and Sugipi, while for comparison, observations were made by Dr. Hadden and myself. It certainly seemed as if the boys were able to recognize the letters decidedly more rapidly than either Dr. Hadden or myself, but I should not like to lay any great stress on the results owing to the imperfections of the method. One set of observations may, however, be given as an example.

Aug. 9th, afternoon. Dr. Hadden, the letter E.

After 2 min. 45 sec. saw a glimmer on the floor of the chamber.

4 = 0 saw sharp line, edge of white patch.

6 = 0 saw black blur in the middle of the white patch.

8 = 15 letter G.

9 = 30 white patch more distinct, can see that it is oblong.

10 = 30 letter E seen, but not certain about it.

13 = 0 still not quite certain about letter.

Apori, letter E, external illumination rather duller than for Dr. Hadden.

Seen correctly in 6 min. 40 sec.

Sugipi, letter T illumination rather brighter than for Apori, but about the same as for Dr. Hadden.

Seen correctly in 2 min. 30 sec.

W. H. R. R., letter R.

7 min. first saw oblong white patch.

11 min. black blur in middle.

15 min. patch quite definite, can see that the letter is more or less square, probably either E, K, R or X, but could not say which.

These observations were made on a dull day and were more satisfactory than those on bright days, as it was more easy to graduate the illumination of the dark chamber.

Although the method was not good enough to allow any definite conclusions to be drawn, the observations so far as they go support Guppy's belief that the eye of the Melanesian adjusts itself to the dark more quickly than that of the European. Guppy believed that this was due to the larger size of the pupil in dark races but another explanation is much more likely. We have now reason to believe that the increased sensitiveness of the dark-adapted eye depends on an accumulation of visual purple in the rods of the retina. We know also that the formation of visual purple is closely connected with the pigment epithelium. In dark races there is reason to believe that the eye shares in the greater abundance of pigment, and it is quite possible that in deeply pigmented races visual purple may be formed more readily and more rapidly than in white races, and it is therefore quite conceivable that dark-adaptation should take place more rapidly. I regret very much that I cannot contribute more positively to the problem, but hope that its investigation may be undertaken again at some future time with more suitable apparatus than was at my disposal.

1 In a recent paper ('Les Natives Oceaniennes,' 1898, p. 176) Guiz states that the natives of New Guinea (Tutu Islands) can see nearly as well by night as by day.

THE VISUAL ACUITY OF AUSTRALIANS.

Observations were made in Malakang on the visual acuity of six Australian natives from the district of Seven Rivers on the East coast of the Gulf of Carpentaria. Four of these learned the method without any trouble, the other two were slower but still better than several men both as Saguanne and Murray Island. The only other point which seems worthy of notice is that they seemed to fatigue more quickly than the natives of Torres Straits. The results from the six natives were 4, 5, 5, 7, 7, and 8, giving an average of \( \frac{5}{4} \). This average is higher than that obtained in Malakang, but this is probably due to the fact that all those tested were young, healthy men.

In all there was marked general pigmentation of the conjunctiva and one had a marked circumcorneal ring. There were slight conjunctival changes, but no case of definite pterygium. The palpebral fissure was narrow and not obviously different from that of the Malakang people.

The observations were made under exactly the same conditions as those under which the Malakang people were tested and, so far as any conclusion is justified from the few cases, one may say that there was no obvious difference between the two races. The ease with which most of them acquired the method and their general behaviour in connection with the testing gave me the impression that they differed little in intelligence from the average Torres Straits Islander and that they are far from being so low in the scale of intelligence as has been sometimes supposed.

Numerous writers have called attention to the sharpness of vision of the Australian aborigines, thus Lumholtz states that, though his own vision was twice as keen as that of the normal eye, it was usually impossible for him to discover bees even after the natives had indicated where they were. The bees were very small and yet the natives would see them flying to their nests in the trees as much as 20 feet above the ground. The powers of Australian natives as trackmen are well known.

The only reference to previous exact observations on the vision of Australians which I have found is in a note on p. 24 of Spencer and Gillen’s ‘Native Tribes of Central Australia,’ in which it is stated that ‘Dr. E. Eykinson found the vision of the natives was not on average better developed than in Europeans.’

VISUAL ACUITY OF POLYNESIANS AND MELANESIANS.

Six Polynesians were examined, five Samoans and one man from Nieuw of Savage Island. One Samoan boy was only examined with Starling’s letters and had vision of \( \frac{4}{5} \). The five examined with the E test gave an average of \( \frac{5}{4} \) with a maximum of \( \frac{7}{5} \). One boy in whom \( V=\frac{5}{7} \) was almost certainly myopic but was not tested with glasses. There were very slight conjunctival changes and little or no pigmentation, except in one Samoan who had in the left eye a large vessel running up to the cornea from below surrounded by pigment.

Two men, half Savage and half English, were examined who had vision of \( \frac{3}{5} \) and \( \frac{4}{5} \).
respectively. The latter had a very marked pterygium in one eye. One boy, half Samoan and half Mahiing, had vision of 1.

Only three Melanesians were examined. Two of these belonged to the island of Tanna, one had vision of 1 and the other only 1/3, owing to corneal opacities. The third came from the Latum district of the island of Santa Maria in the Banks Group. His acuity was only 1/3 and in the right eye he had an extremely well-developed pterygium, forming a large raised swelling, spreading down over the cornea to the bottom, where there was a good deal of ulceration. The pupil however was not obscured.

Nine half-castes were examined whose mothers belonged to the western tribe of Torres Straits, while the fathers were Melanesian, of these six were from Tanna, two from Uta in the Loyalty Group, and one from Sandwich Island in the New Hebrides. The average for the nine was 13/31. In two, V = 1/3, and two were almost certainly myopes, one having vision of only 1/3. All were between the ages of 12 and 23. The conjunctival changes were slight in all, but several had marked pigmentation, with a well-developed cirruncorneal ring in two cases. It was among the boys in this group that I met most frequently with cases of learning the test by heart.

**Conclusions.**

The general conclusion which may be drawn from the preceding account is that the visual acuity of savage and half-civilized people, though superior to that of the normal European, is not as in any marked degree. There is no doubt that error of refraction producing defect of vision, and especially myopia, are much more common among civilized people, but when this source of difference is excluded, the races which have so far been examined do not exhibit that degree of superiority over the European in visual acuity proper which the accounts of travellers might have led one to expect. It is true that exceptional individuals have been met with by Kotelchuna and Cohn whose acuity distinctly exceeds anything that has ever been recorded among Europeans, but the general average has not shown the same superiority, and this is especially well marked in the observations made in Torres Straits where the results obtained are representative of complete communities.

Although the visual acuity (in the strict sense) of the Torres Straits Islanders was not found to be in any way extraordinary, their visual powers were, I think, equal to any of those which have excited the admiration and wonder of travellers elsewhere. Travellers have repeatedly called attention to the way in which savages are able to distinguish birds among the thick foliage of trees, and the quickness of the natives of Torres Straits in this respect was very striking. The power of distinguishing boats at a distance was also remarkable. We usually found, however, that as soon as a native had seen a boat and pointed out its position to us we were able to see it, but while we could perhaps barely see the boat, the natives would describe its rig and in some cases knew what boat it was. Their visual accomplishments in this respect were obviously of a kind in which special knowledge would be of enormous importance.
The most striking visual feat which came under my notice occurred when I was sailing from Makura into Thursday Island with three natives. Two or three weeks before, a new Government steamer had arrived in the Straits, which the natives could only have seen on one occasion. On turning a point of land at some distance from Thursday Island all three natives simultaneously shouted out and then told me that the steamer was in the harbour. At that time I could see nothing of the steamer, but when much nearer, found that there was a steamer on the far side of Thursday Island. The low-lying end of the island was between us and the steamer so that it was impossible that the natives could have seen more than the tops of the masts. The visual acuity of the best of these three men was 1/4. We had been discussing the wire-boatmen of the steamer on our way and it is possible that the men only made a lucky guess, but from the unanimity with which they called out I have little doubt that they really recognized the presence of the vessel by seeing the tops of its masts from a great distance.

Banke, who lived for some time among the Batak of South America, has given a very interesting account of his experiences. On first going among the natives he regarded their visual powers as something wonderful, but after living among them for some time he says that the vision of the Indian lost its wonderfulness. He found that it depended very much on the knack of noting certain details and that, although myopic, he was able with practice to see and distinguish objects almost as well as the natives. Banke is of opinion that the superiority of the savage is greatly due to practice in the adjustment of accommodation for distant objects, and believes from his own experience that with practice one can adjust accommodation for very much greater distances than is commonly supposed. The power of seeing birds in trees depends, according to him, in great measure on adjustment of accommodation. He also gives one instance which shows very well the great importance of special knowledge. He was so far astonished at the way the Indian could tell the sex of a deer at a distance which would have implied vision at an extremely small angle if the distinction had depended on seeing the antlers. After a time, however, he noticed the peculiar gait of one deer and this led to the discovery that the Indian distinguished the sex by speciality of the gait of the male. Having once noticed this peculiarity he found that he was able to recognize the sex of a deer at as great a distance as could a native.

The instances which have been given will suffice to illustrate the special nature of the visual powers of those who live in a state of nature. We have at present very insufficient knowledge of the degree of visual acuity in Europeans with normal refraction, but so far as our data go it seems that the savage stands with visual acuity which is but slightly superior to that of the average normal-sighted European. By long-continued practice, however, in attending to minute details in surroundings with which he becomes extremely familiar, the savage is able to see and recognize distant objects in a way that appears almost miraculous, but it is doubtful whether his visual powers excel those of the European who has trained his vision to any special.

1 Correspondenzblatt für deutsche Geologen, f. Anthrop., B. 118. 1897.
end. There is little doubt that the most acute sighted savage transferred to a Scotch roast would, in the unfamiliar surroundings, be a very poor match for the gullie, and, in fact, it has been found that the Australian tracker is of little or no use out of his own country.

The possible influence of accommodation which has been suggested by Ranko is a matter about which it is difficult to express any definite opinion. It is generally assumed by ophthalmologists that the amount of accommodation which takes place for distances greater than about 6 metres is negligible. It is however possible that delicate gradations of accommodation may take place which adjust the eye to much greater distances than this, and there are a few facts which fall in favour of this view. There seems to be a certain amount of correlation between acuteness of vision and the development of accommodation. The visual acuity of some birds, such as the hawks, 

The frequency of hypermetropia in savage races may also have some importance in this connection. It is one of the consequences of hypermetropia that accommodation becomes necessary even for the most distant vision. In the hypermetope the mechanism of accommodation is always more or less in action, and it seems quite possible that with the more extensive use of accommodation, there may be associated a higher degree of delicacy of adjustment than exists in the emmetropic eye, and that by practice this may become in the case of the savage one of the causes of his superiority over the European.

There is no doubt that the savage is an extremely close observer of nature. In Torres Straits we were continually meeting with instances which illustrated the powers of the natives in this respect. Nearly every detail of landscape and seascape had its special name and nearly every species which the zoologist or botanist would recognize as distinct was also differentiated by the native and had its distinctive name. In the ease of familiar plants, such as the pap or banana, there were many named varieties.

Minute distinctions of this sort are only possible if the attention is predominantly devoted to objects of sense, and I think these can be little doubt that such exclusive attention is a distinct hindrance to higher mental development. We know that the growth of intellect depends on material which is furnished by the senses, and it therefore at first sight may appear strange that civilization of the sensory side of mental life should be a hindrance to intellectual development. But on further consideration I think there is nothing unnatural in such a fact. If too much energy is expended

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The whole subject is illustrated in a very instructive manner in Radin-Napier's "Aids to Socialism." Trust the wish to understand the visual powers of the savage cannot do better than read pp. 30 to 31 and pp. 61 to 77 of this book.

of the sensory calculations, it is natural that the intellectual superstructure should suffer. It seems possible also that the over-development of the sensory side of mental life may help to account for another characteristic of the savage mind. There is, I think, little doubt that the uncivilised man does not take the same aesthetic interest in nature which is found among civilised peoples. Banks has made some interesting observations which help to explain this fact. Naturally a great lover of scenery, Banks found after living in South America, learning to see things as the natives saw them, that he had lost his capacity for the aesthetic enjoyment of scenery; he found that individual objects forced themselves upon his attention and prevented his enjoyment of the scenery as a whole. He also found that, owing to the fact that he was continually attending to details, any one of which might be important, he was unable to devote attention to the more serious problems of life. Banks’s experience is strongly in favour of the view that the predominant attention of the savage to concrete things around him may act as an obstacle to higher mental development.

Observations with Masson’s disc.

The sensibility to differences of brightness was tested by means of Masson’s discs rotated on a colour wheel. In the ordinary form of these discs black patches of equal size are placed in a radial line on a white disc. When the disc is rotated, the disc shows a series of grey rings gradually diminishing in darkness from centre to periphery of the disc, and shading off till they become invisible. The just perceptible difference is determined by finding the faintest ring which can be seen.

The only account of previous ethnographical work on this subject which I have been able to find is that given by Schöler of observations made on some Nubians in an exhibition in Germany. He found that some of these Nubians were able to distinguish fainter rings than Schöler himself in spite of the long practice of the latter in this kind of observation. One man could distinguish a ring which differed from the background by only 2.5%, while the highest degree shown by Schöler himself was represented by 3.4%.

In my observations, I used discs on each of which there was only one patch in a position which was unknown to the observer. For this purpose two parallel radial slits were made in each disc at a distance of from one to two millimetres from one another. A strip of black paper was then passed transversely through these slits so that on the front of the disc a narrow black patch was seen which could be placed at any distance from the centre. A series of six discs were used with the black patch at different distances from the centre. Unfortunately one of these was destroyed before I had determined the exact distance of the ring from the centre. The results with another disc were found to be unsatisfactory because the ring was too close to the periphery of the disc. On rotating a simple white disc and examining it carefully, as would be done in looking for a ring, the outer edge may often appear whiter than the rest (owing to contrast against the darker background), while inside this may be

1 Zeitsch. f. Ethnol., Bd. xii. S. 67. 1903.
seen a darker ring. If the objective ring is too near the background, these contrast effects may increase its darkness and deceptive results may be obtained. As a matter of fact, I have found that a ring may be recognized near the periphery which differs less in intensity from the background than one situated farther from the periphery of the disc.

The results given were obtained by means of 4 discs with rings differing in brightness from the background by the following fractions—

No. 1 3\(\frac{1}{8}\) No. 2 3\(\frac{1}{4}\) No. 3 3\(\frac{1}{2}\) No. 4 1\(\frac{1}{2}\).

The method employed was to put No. 1 on the wheel, cover it in front and set the wheel in rotation. The native was then called up, the wheel uncovered and he was asked whether he could see a ring (gogob); if he said he could see one, he was given a piece of grass and asked to point out the position of the ring. He then went away out of sight and the operation was repeated with the same or another disc. Owing to the fact that the colour wheel was lost till near the end of our stay in Murray Island, I was unable to make as many observations as I should otherwise have done, but I was able to examine 24 individuals in Murray Island and Mabuiag, viz. 12 men, 11 boys and 1 girl.

No. 1 was seen by nearly all; the only failures were in the cases of the Manus of Murray Island, whose sight was very defective; Smoke, who was always a careless observer, and two boys, who were also careless.

No. 2 was seen by five adults and four children.

No. 3 was seen by the same five adults and by two of the children.

No. 4 was seen quite definitely and on every occasion by only one man, Makel. Another man, Jimmy Rice, located the ring correctly twice and failed in three other trials. He had seen No. 2 and 3 easily. Warin of Mabuiag only located the ring correctly on the first trial after searching the disc for a long time; in later trials he was twice right and twice wrong. Only one boy (Jimmy Rice, jnr.) was right with this disc and that only on one occasion. He had seen No. 5, but not markedly.

These results seemed to show that some of the natives had a much higher degree of sensibility than had been previously recorded for European vision. So far as I know no observations by this method have been made on a large scale on Europeans but the highest degree of sensibility which I have found recorded by those who have used this method for researches on Weber's law is represented by 3\(\frac{1}{4}\) (Olive Bully). In Torres Straits five adults and two children recognized a ring of about the same intensity as this, viz. 3\(\frac{1}{4}\), and one Murray Island native could distinguish with ease a ring which only differed from the background by 3\(\frac{1}{2}\), while two other natives recognized the position of this ring two and three times in five. This degree of sensibility seems to be so great in excess of what has been recorded among Europeans that I was inclined to be incredulous. On repeating exactly the same procedure since returning to England, I found that some individuals gave as good results as were obtained by Makel of Murray Island. Of 25 individuals examined all could see No. 1, nine could

\[1\text{ Arch. J. Ophthalm. R. Xxvi. Math. l. B. 27. 1901.}\]
distinguish No. 2; eight distinguished No. 3 correctly, while no less than five could see No. 4. The 29 individuals examined had had no previous practice.

The discrepancy between these results and those of earlier observers may have been due to some feature of my method or it may have been that previous observations have been made on laboratory workers whose visual powers are below the average, or at any rate below that of many individuals.

One feature of my method was that the observer was allowed to come as close to the disc as he liked and to look in any direction he liked. This was done in order that the natives should be as free from constraint as possible and it was also necessary that they should be near the disc in order to be able to point out accurately the position of the ring. Other workers have seated their observers at a given distance from the ring. It is possible that this difference in procedure may have something to do with the smaller difference threshold which I have found.

It is more probable that there was some defect of the No. 4 disc which made the gray ring darker than it should have been, but I have not been able to satisfy myself as to the nature of this defect. For the present purpose it is sufficient that the Papuans tested have not shown any superiority over Europeans tested by exactly the same method and with the same discs, and I do not wish to lay stress on the absolute threshold.

The observations in Torres Straits brought out one further suggestive point. Mabo, who had the highest degree of sensibility among the men tested on Murray Island, was the native who had the highest visual acuity, viz. 1.7. Jimmy Rico, who came next in order of sensibility, was also second to Mabo in visual acuity, viz. 1.5. Of the boys Jimmy Rico, jnr., who gave the best results with Mason's discs, had also the highest visual acuity, viz. 1.5. These results suggest that there may be a close relation between visual acuity and the power of distinguishing differences of brightness as tested by means of Mason's discs, and I am making further observations with the aim of finding if the two conditions are correlated.
3. COLOUR VISION.

The colour vision of primitive races has excited interest mainly in its philological aspect and has been construed especially in relation to the hypothesis that there has been considerable modification of the colour sense of man within historical times. This question was first raised by Gladstone, who from a close study of the epithets for colour used by Homer came to the conclusion that the people of that age could have distinguished little more than differences of brightness and darkness. Geiger later advanced the view that there had been a definite evolution of the colour sense in man; that at one period of his existence he had distinguished nothing more than differences of brightness; that red had been the colour first distinguished and then the discrimination of other colours had developed in the same order as that of the arrangement of the colours in the spectrum, the power of seeing blue and violet having been the latest to develop. These views of Geiger were based entirely on philological evidence derived from a wide study of ancient literature. He was supported by Magnus, also on philological grounds, but it was generally held that these writers were not justified in their conclusions and that the close relation between language and sense which these authors supposed to exist was far from being a fact. It was also found by Virehov and others that savages might have exactly the same peculiarity of colour nomenclature which are found in ancient literature and might yet have a well-developed colour sense, while various theoretical objections to the views of Gladstone and Geiger were raised.

The controversy gave rise to an extensive literature which it would take too long to consider here. It must suffice to say that Magnus collected a large amount

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5. So far as I know, Brinton (Zeitsch. f. Ethnol. Bd. x. S. 65, 1893) was the first to call attention to the colour language of savage or barbarous races in his hearing, but the controversy, while in addition to the powers of Magnus an important contribution was made by Andree (Zeitsch. f. Ethnom. Bd. x. p. 529, 1876).
of evidence from existing races of mankind showing the same kind of defect of colour language which are found in ancient literature and argued that these defects must have some definite basis, probably of a physiological nature. In general, however, the views of Gladstone and Geiger have been wholly rejected and it has been supposed that there is no necessary connection between colour language and colour sense.

One of the chief interests of the work described in this report is that it shows that defect in nomenclature for a colour may be associated with defective sensibility for that colour and so far lends some support to the views of Gladstone and Geiger.

Observations with Holmgren’s wools.

I began the investigation of colour vision in Torres Straits with Holmgren’s wools. The three test-wools used by Holmgren for the diagnosis of red-green blindness were supplemented by four others—a bright green of about the same degree of saturation as Holmgren’s red, a yellow, a blue, and a violet. The three latter wools were of medium saturation, the violet being rather less saturated than the others. Holmgren’s wools are very different in yellow examples and in any set used for ethnographical purposes this defect should be remedied.

The seven test-wools were used in the following order:—red, green, pink, Holmgren’s green, yellow, blue, violet. Red was selected to begin with owing to the familiarity of the natives with this colour and the consequent ease with which they were made to understand the process of matching. Whenever the matches with any wool were in any way abnormal the wool was repeated at the end of the series.

The natives understood what they were required to do very readily in most cases, and among over 200 individuals examined I only met with one man, a native of Kiwa1, with whom there was any doubt as to whether he understood the process of matching. In some cases the natives would select a number of wools and spontaneously arrange them in order of similarity to the test. When a number of wools were chosen which included one or more bad matches, the wools were laid out in a row, and the native was told that one wool was “no good,” and was asked to pick out that wool. In other cases, the native was asked to pick out from those selected the wool most like the test, and then the next and so on, when in nearly all cases the faulty wool would be left till last; the latter procedure is more satisfactory, as one need not suggest that any of the matches are bad.

Care was taken to avoid the names of the colours as much as possible till after the matching was completed. There was a natural tendency to put together all the wools to which the same name was given, thus in Morey Island, Holmgren’s green wool was often called kaekekakok (white) or pipi (grey), and there was a tendency to place with it other unsaturated wools of any colour to which the same name would be applied. One could often hear a native saying “kaekakakok” to himself as he picked up a colourless wool to place with the green, and there is no doubt that

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1 See p. 52.
this was a source of fallacy especially with the pale green and the violet tests. Every case was taken not to account for this tendency by mentioning the names of the colours, but there is no doubt that the difficulty must always exist in ethnographical investigations when colour nomenclature may be on a very different level to that of civilized races.

Another source of fallacy may be noted. The wools were often taken up into the hand as they were chosen, and in such a case the native was liable to match, not with the test, but with the test-wool taken into the hand. Consequently after each wool had been chosen it was placed on one side.

In testing for colour-blindness, it is always important to record not only the actual matches made, but also any wools compared with the test, and I noted every wool which was even tentatively compared with the test-wool. If this feature had been neglected, even the few cases which excited suspicion of colour-blindness would have been passed as absolutely normal.

In Murray I noted 107 individuals were tested; 56 men, 7 women, 31 boys, and 13 girls.

The red wool was matched readily by all. As it was the first wool used, mistakes were made by several owing to misunderstanding, but in all these cases this wool was repeated at the end of the series. A considerable proportion matched it with a saturated pink as well as with red wools. The bright green wool was matched readily, when blue-greens were matched with it, and in a few cases almost pure blue wools. The pink wool (Holmgren’s test) was matched very readily by all, though the majority refused to take pink wools if much less saturated. Two young boys picked up and compared a green wool, but I was quite satisfied that this was only due to carelessness. The pale green wool (Holmgren’s test) was matched correctly by the majority, but in a large number of cases it was matched with a number of bluish or violet wools of about the same saturation, while seven individuals matched it with neutral wools with a faint pinkish tinge. The yellow wool was matched correctly by nearly all. Two men and five children matched it with reddish wools. One man and three boys compared this wool with blue wools. One boy was one of those who compared pink and green and both his consonants and that of the other boys I believe to have been due to carelessness, but the man (Mapauli) did the wools otherwise so well that this abnormality appeared very strange.

The blue test-wool was matched by 37 individuals with violet, as well as with blue or bluish green wools. One man matched it with an almost colourless wool and another with a brown wool. This man (Rooke) also compared the blue with a yellow wool. The violet wool was matched or compared by 12 with neutral wools and by 14 with distinctly reddish or pinkish wools. One boy (Depoma) matched it with a brown wool, and the Manus matched it with a blue and a green wool of about the same saturation, calling all “k-balakelak.”

1 In some more recent work in Egypt, I have found that this tendency to match wools to which the same name is applied may, in some cases, lead to results which make it impossible to decide whether an individual is colour-blind or not by means of Holmgren’s wools alone.
The most definite result of these observations was that there was no red-green blindness. The matches made with the pale green wool might be regarded as evidence of this defect, but I have no doubt that the matches with neutral or even faintly pinkish wools were due to the influence of language to which I have already referred. No single individual matched, or even transiently compared Holmgren's pink wool with blue or violet, the most frequent confusions which occur in red-green blindness.

The fact that the violet test-wool was matched by no less than 14 with pinkish wool might also be regarded as suspicious, but I have little doubt that it was not due to any weakness for red. Confusion between pink and violet may be due to insensitiveness to red, but it may also be due to insensitiveness to blue, and in the case of these people the latter was the probable cause.

Confusion between green and blue was very common and also between blue and violet, and there was obviously much more imperfect discrimination with these colours than in the case of red.

There was more reason to suspect the existence of yellow-blue blindness, rare as that condition is among Europeans. Two men compared yellow and blue wools though they did not actually match them, and several children made similar errors. One man matched blue with a brown wool. The other tests of these individuals were not, however, of the kind that would be made by cases of yellow-blue blindness, and I believe the explanation, so far as the confusion was not due to carelessness, to be that the yellow test-wool used by me was a dull yellow while blue was also regarded by them as a dull colour (see p. 55). The men who made the comparisons of yellow and blue were not people with whom I had much to do, and I had considerable difficulty in getting one of them to understand the method when testing visual acuity.

These observations became of importance in connection with the fact that Schöler described a Nubian examined by him in Berlin as probably yellow-blue blind. This was because he saw and orangy with purple; blue with yellow and grey, and yellow with blue and grey. The mistakes made by this man were much more faulty than anything that was done by any Torres Straits natives, but it is noteworthy that the suspicious cases met with in Murray Island made mistakes in the same direction as Schöler's Nubian. The subject is of great importance, for it would be very remarkable if yellow-blue blindness, so rare among Europeans, should be present in other races. I may mention here that I later met with cases of red-green blindness among natives of Lofo and the condition was so marked in them that there could not be the slightest room for doubt, while the suspicion of yellow-blue blindness in Murray Island was only based on transient comparison of unlike wools. I believe that the tendency to confuse blue and yellow was due to the cause I have already mentioned, but I do not feel the same confidence in denying the existence of some defect as regards these colours which I feel in the case of the common form of colour-blindness.

Twenty-eight individuals belonging to the western tribe of Torres Straits were

1 The wool was constituted and the faulty comparisons or matches were probably also in part due to the influence of language. When asked the name of the violet test-wool, it was usually called kahakakeh (white), and occasionally keh manamana (little red).

2 Zeitsch. f. Ethnol. 16th. 59. 1882.
examined. Of these 22 belonged to the island of Makosig or Bala, four to Muranig, one to Maa, and one woman to Suhai. Of the 22 individuals from Makosig and Bala, 15 were men, six boys, and one a girl.

The general results closely resembled those of Murray Island. The matches with the red wool were normal except that eight matched with pink as well as red. The pale green wool gave, as in Murray Island, doubtful results; eight individuals matched it with bluish wool, four with violet wool, and four with very faint pink wool, but in all cases the wools chosen were very pale, and I believe that the matches were influenced by nomenclature; thus Mengui, who matched this wool with neutral, yellow, violet and pinkish wools called all miselahungs (white). Violet was matched by nine with colourless or almost colourless wools, and by three with pinkish wools. Blue and violet were also confused.

There was no single case of suspicious matching or comparison of the pink test with blue or violet, while the behaviour in matching with blue and violet was consistent with some degree of insensitiveness to these colours.

Seventeen individuals, all males, were examined belonging to the Fly River district of New Guinea. Thirteen of these belonged to the island of Kiwi (Ipsia eight, Sagiane one, Habondane three, Sotnai one), two came from Mawatta on the mainland of New Guinea, one from the island of Parana and the locality of the remaining man was doubtful.

Red was matched with pink by eleven men. The matches with the pale green wool resembled those in Murray Island and Makosig. Yellow was matched by one with a greenshade-blue, blue was confused with violet by nine, while violet was matched by three with blue, by two with greenshade wools, by four with neutral wools, and by two with pinkish wools. The most noteworthy feature was the large proportion who confused red with pink, while confusion of green, blue and violet was much more common than elsewhere. It will be noted that one man confused yellow and blue-green wools.

When, however, this man was told that one of his wools was bad, he at once picked out the blue-green wool from the rest and rejected it.

It was in Kiwi that I met with the only individual, a man named Eubogo, who failed to understand the method of matching although he had seen others doing it correctly. Many of the wools he picked up were consistent with his being red-green blind, but from his behaviour I came to the conclusion that he failed to understand the method. I also failed to render the method of testing visual acuity intelligible to him (again the only case of failure). It is, however, just possible that he was colour-blind, and it was very unfortunate that, owing to the shortness of our stay in Kiwi, I was unable to examine him again. I may mention that he gave the names of colours fairly correctly except that he first called blue dogiogog (red) before calling it wiwa-wibuna (the customary name).

Altogether, in Torres Straits and the Fly River district of New Guinea, 152 individuals were tested of whom 140 were males. With the just possible exception of Eubogo, there was not a single case of red-green blindness, although this condition exists in about 6 per cent. of the male European population. This can hardly be due to chance, and I think the number examined is sufficiently large to justify one in...
COLOUR VISION.

COLOUR NOMENCLATURE.

The names used for colours were next investigated. I first obtained the names of a set of papers sold by Rotha, of Leipzig, which are now so largely used by workers on colour vision that they may be regarded as standard colours. The set includes the following—red, orange, yellow, yellow-green, green, blue-green, blue, indigo, violet, purple, white, and two blacks. I also used some grey papers sold by Rotha and I obtained the names of the test-woods and of various brown woods, and often asked the names of the colours of various objects. A few colour names were only obtained when working with the tintometer or when showing contrast colours. It is important in collecting colour vocabularies to use more than one method. It is very dangerous to trust to the names of the colours of natural objects, as it sometimes happens that the colour of a given object may have a special name which is not applied to that colour apart from the object. I obtained the names for colours from a large number of individuals independently of one another, and then compared the different lists and questioned some of the older natives when discrepancies were found. Often lively discussions were started among the natives as to the correct name of a colour, and I always endeavoured to profit by these. It was found that the names of the colours could only be satisfactorily obtained from the older men. The children hardly knew the names at all, and the young men were little better, while even middle-aged men would sometimes say that they did not know the names properly and wished to consult older men. Even in so simple a matter as colour nomenclature native knowledge is rapidly being lost.

The women did not appear to know the names of colours as well as the men and they were also less critical about shades when being tested with Hering’s woods. One somewhat ludicrous incident occurred in getting colour names from one elderly woman in Murray Island. She gave me names which I had received from no other native. On going through the papers a second time her names were fairly consistent with those first given, and she thought seriously about each colour and was evidently not giving names at random. I discovered that she had given me her own name for the first colour shown her, and for the other colours had given the names of her friends. The names she gave were somewhat certainly dependent on associations of some kind, probably connected with dreams.

In Murray Island red was called manamamam poured purple and pink were called

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1 Additional evidence against its presence will be given in the section of observations with respect to tintometer.

2 The names given papers of Rotha were so much alike that I had intended to use only one of them, but it soon appeared that they were readily distinguishable and were given different names by groups.

3 I also asked some of the men to pick out all the woods and show me objects to which they would apply a given colour name.
kebe manamanaman (little red) by many, in which cases the red paper was often called an manamanaman (bright red). One man, however, reversed these names. Another name often used for pink and purple was xinikikini, and these colours were also called xinikiko-manamanam and xinim-xinim-manamanam.

Orange was called banban by nearly all, but it was called manamanaman or kebe manamanaman by a few. It was also occasionally called miiiina. One called it maiiram.

Yellow was called banban by most; simin by a good number, more rarely xisigiga or xonkoko-xonkoko and susieriseri by one.

Yellow-green was called xasokokasek by the majority; also xisigiga, xasigga, and xlemagga. A few called it susieriseri. One man called it banban xolegole (yellow-black), and one young man called it karen gaanga (sea-green), pointing at the same time to the position of a large reef over which the shallow water had very much the same colour as that of the paper.

Green was called xasokokasek by most; also gaanga, xlemagga, susieriseri, giisiga, and kebe simin (little yellow).

Blue-green was called by the same names, susieriseri being rather more common. It was also called xop-xop simin (dirty yellow).

Blue was called bun-bun, xolegole, susieriseri, gaanga, giisiga, xlemagga, akonoako, and xasokokasek.

Indigo was called either buibulu or xolegole with much more unanimity; by a few it was called susieriseri and by two or three individuals xareen xolegole (blue-black).

Violet was called xolegole or buibulu xolegole; also akonoako, kwenkwen (dark), xikunikuni, susieriseri, xolegole susieriseri, kebe manamanaman (little red) and manamanankindake (red-white).

White was called kakekakek by the great majority; also susieriseri, and xasigga-xasiga.

Deep black was called xolegole or xol xolegole; one man called it kikikiki.

Dull black was called xolegole or kebe xolegole; also pipi, pipi xolegole, xobogodo, xobogudo and xop-xop.

One grey (162 W + 188 Bk) was called xakakakak, kebe xakakak, pipi xakakak, or pipi xanamancan.

A darker grey (450 W + 311 Bk) was called pipi, xobogodo or xolegole. The name applied to a given grey depended a good deal on the paper which had been previously shown. If the previous one had been white or a light grey, a dark grey might be called xolegole, while if shown after black the same grey would be called pipi.

Helmingen's pale green xosxedo-wool was called kakekakek, pipi, kebe banban, susieriseri and xonkoko-xonkoko. The violet xosxedo-wool was called pipi, xakakak, xanamancan, kebe manamanaman, and occasionally xolegole.

Brown wools were called kebe manamanaman, kebe banban, pipi, xolegole, akonoako, according to their prevailing tone and shade.

It will be seen that there was great definiteness and unanimity in the nomenclature.

1 i.e. a grey matched by mixing 162 parts of white and 198 parts of black on the colour wheel.
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turn for red, rather less so for orange and yellow, less so for green, and very great indefiniteness for blue and violet. Săukumakewp was evidently the most definite word for green, while the word used most frequently for blue and indigo was bōhōbili, which was the English word reduplicated and with the continuous consonants separated. The old men agreed that their own proper word for blue was goleqego (black), and they regarded it as quite natural to apply this name to the brilliant blue of the sky and sea.

Differences of brightness and saturation were chiefly named by means of the words an (big) and kēhe (little); dēlo (good) and wéd (bad) were occasionally used in the same sense. Ogōg (dirty) was also used sometimes for less saturated colours. Dādu was also occasionally used for slightly saturated colours and for dull black, but I do not know the usual meaning of this word.

The word which gave me most difficulty was akōske. I first met with it as a name for blue; later as a word for brown, and I was at one time inclined to think that it might be a word for the latter colour, but it was certainly used also for blue and violet and I believe that its correct translation would be "dull," as opposed to brilliant or bright. In the observations made with the tintometer akōske was occasionally used as a word as qualifying other colours, thus a fān̓a yellow glass was called akōske bāmbom. It is possible that this word may furnish a clue to the tendency to compare blue with brown or dull yellow (see p. 51); it is possible that the natives who confused these colours may have thought of them both as akōske.

The word "sëwamawm" evidently meant "bright." It was used occasionally for bright colours such as yellow. They apply this word to the colour of the skin of the white man as opposed to that of their own (goleqego), and they also use it for those natives who are lighter in colour than the rest, for cases of partial albinoism and for half-caste. It was never used spontaneously for white, but they would agree that white and other bright objects were all sëwamawm. Another word, mōnikom, apparently meant bright or glittering.

The word "kapekpe" probably means "dark," but it is now used by the missionaries as a word for dark in the sense of wicked, and was only used as a name for a dark colour by one or two women.

Particolored objects were called "warwar;" the word was applied to marks or patterns of any kind. Writing, for instance, was called warwar.

I had much trouble in endeavouring to ascertain if there was an abstract term for "colour." In Haden and Bay’s Murray Island vocabulary "warwar" is given as a word for colour, but there is no doubt that this means particolored. The nearest approach I could find to a generic name was "gimpam." Green was often called bālum gimpam (bālum = leaf) and occasionally other colour names had the same suffix as "baluld gimpam," "kamikam gimpam." It was used for colours of woods and of the tintometer and could not therefore have been used for paper in a sense which I

1 It is possible also that gimpam (used mainly for green, yellow-green, and once as twice for yellow) may also have signified "bright" or "light" as opposed to dark.
at one time suspected, It is perhaps in favour of this term that a similar word “guam” was probably the nearest approach to an abstract word for colour in the Western tribe of Torres Straits.

Another word which was occasionally used as if it might be an abstract word for colour was mairmair. Mair was red ochre and mairmair was apparently an old word for red, although very rarely used now. It was used by only one or two individuals in the same way as gingam, and a very intelligent young man, Jimmy Waie, who knew English well, told me that “mair” meant colour. It would be interesting if a word for red should become an abstract term for colour.

Colour adjectives in Murray Island are formed by reduplication from the names of various natural objects. In the following table is given a complete colour vocabulary of this island with the derivations, the chief names being printed in capital letters.

<table>
<thead>
<tr>
<th>Murray Island Colour Vocabulary with derivations.</th>
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<tbody>
<tr>
<td>MANAMAMAM</td>
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<tr>
<td>Kiamukiam</td>
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<tr>
<td>Koba-mamamam</td>
</tr>
<tr>
<td>Sunser-mamamam</td>
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<tr>
<td>Mairmair</td>
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<tr>
<td>BAHAMAM</td>
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<td>BUSHU</td>
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<td>Zombeherbush</td>
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<td>SOLKESUSSKEP</td>
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<td>Lolen gingham</td>
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<td>Saseernar</td>
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<td>BULBUULU</td>
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<td>Zeraezeraaz</td>
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<td>GOLGOOLE</td>
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<td>Buufred</td>
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<td>PIF</td>
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<tr>
<td>Kolegolekegote</td>
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</table>

It is interesting here that of the words in common use I only failed to obtain the derivations of the words for “white” and of sumser and akholo, meaning respectively “bright” and dark or dull. I also failed to find the derivation of three words which were rarely used in the sense of dark, viz. kepekpeke, kukiuki, and kaderieka. All the other names used for colours were found to be derived from natural objects which could be identified. Some of the objects from which colour names were derived were brought to me by the natives and are now in the Museum at Cambridge, viz. bom, eroo, zom, and kegote. I recorded the colours of somer and zom with Love-
COLOUR VISION.

brow's tintometer. The colour of each was more saturated than the necessary combination of glasses and had to be diminished by the addition of neutral glasses to make a match. The matches were:

\[
\begin{align*}
\text{Palp of Somer} + 20 \text{ neutral} & = 200 R + 26 Y, \\
\text{Pets of Zen} + 20 \text{ neutral} & = 115 Y + 32 R.
\end{align*}
\]

Other points of interest will be considered in connection with the Mabugag vocabulary.

THE WESTERN TRIBE OF TORENS STRAINS.

The following names were given to the papers and woods by natives of Mabugag and Bado.

Red was called kulihodgamanlinga by nearly all; paranmadgamanlinga by a few. Purple and pink were called kulihodgamanlinga or tata kulihodgamanlinga by most; several called these colours irukadgamanlinga, and they were also called bobaadgamanlinga and lehodgamanlinga by individuals. One man, Kanai, Master of Bado, called both the red and pink woods wimakalunga (white or bright).

Orange was called murodganlinga or tata murodgamanlinga by the majority; other names used were paranmadgamanlinga, dianaadgamanlinga, wodgamanlinga and arukadgamanlinga.

Yellow was called murodgamanlinga by nearly all; also dianaadgamanlinga, brenagdganlinga, and paranadgamanlinga.

Yellow-green was called idgegamanlinga or tataidgamanlinga, the latter often qualified by "tata" or "amakatama.

Green, mukidgamanlinga or idiegamanlinga.

Blue-green was called mukidgamanlinga most frequently; also idgegamanlinga, gidgamanlinga, milidgamanlinga, braidgamanlinga, wulidgamanlinga and kisawat.

Blue was called mukidgamanlinga by most; also idgegamanlinga, mukidgamanlinga, dianbadgamanlinga, mukidgamanlinga, iroagdamanlinga, and kibikadgamanlinga.

Indigo was called mukidgamanlinga by nearly all; also idgegamanlinga, buladgamanlinga, and kibikadgamanlinga.

Violet was called mukidgamanlinga by several, sometimes qualified by "tata"; it was often called kibikadgamanlinga or kibikadgamanlinga; also idgegamanlinga, iroagdamanlinga, milidgamanlinga, and shahaun.

White was called wakalunga by most; also meruakalunga, karahodgamanlinga, dainadgamanlinga, etc.

Rock was called kihokadgamanlinga by nearly all; also tataidgamanlinga and kihokadgamanlinga.

Greys were called kibikadgamanlinga, kibikadgamanlinga, buadgamanlinga, semadgamanlinga or mukidgamanlinga according to shade.

The pale green test-wool was most commonly called wakalkalunga or saradgamanlinga, and the same names were applied by many to the violet test-wool.

III. 8
No definite word was obtained for brown. Dark browns were called kubikubina or kudugumulina; lighter browns were called mardugumulina, often qualified by "amadan" or "tata," while narumudugumulina, wudugumulina, etc., were also employed.

The chief features of the colour vocabulary resemble those of Murray Island. There was a very definite term for red, and also a perfectly definite term for yellow, which was also used for orange. Malugumulina was used for both green and blue, while idugumulina was also used for both these colours, though it may be regarded as more properly a term for green. These four colour terms were used by the large majority of individuals, but in addition many other terms were used for special tints and shades. Some individuals contended themselves by using these four terms, perhaps with qualifying adverbs for some colours, but most gave special terms for many other colours. Some individuals gave a very large number of such names, many of which were almost certainly derived on the spur of the moment by adding "degumulina" to the name of some natural object which the coloured paper or wool most nearly resembled. One old man, Gini, was especially apt in this direction and gave me over 30 names for different colours, and could probably have given many more. These names cannot, however, be regarded as colour names in the strict sense and were certainly not in general use. Other instances have been given of savage languages with a very large colour vocabulary; thus Kirkhoff states that some natives of Queensland examined by him in Germany had 70 colour names, but there is little doubt that these were of the same nature as those given to me in Mabung.

The tendency to devise special names may be a source of fallacy when colour vocabularies are collected from only a few individuals; thus I was given names for several special brown, but I was able to satisfy myself completely that none of these were genuine words for brown, and that there was no word in the language which could be used for all these colours which we recognize as brown.

Among these people there was a native word for blue which was also used for green, but other names, which were occasionally used for blue, such as idugumulina, kubikubina and idiligumulina were also used for dark colours or for black. The confusion between the terms for blue and black was present, though in a less degree than in Murray Island.

Differences of brightness and saturation were denominated by using "tata" little, and "amadan" nearly ("close up" in pidgin English). Mige (big) was used once or twice. Tuta (dirty) was used less commonly than the corresponding word "ogyug" in Murray Island.

I could not be sure that any term was used for "bright," equivalent to sunnr- sunshine in Murray Island. "Mikalunga" was used for the colour of the skin of the white man, and also for those natives whose skins were lighter than usual, but this was also the common term for white. I have mentioned that one man, Kani, called red and pink wools mikalunga, and I think he was probably using this term in the sense of "bright. Another term which was used rather widely was sarugumulina;
it was used for grey and for both the pale green and the violet tint/'words, and may possibly be translated "drill."

Minir was used for marked or variegated surfaces, whether coloured or in black and white. It was apparently exactly equivalent to the "warowar" of Murray Island. Patterns were called "minir," and this term was also used for smudging marks.

As in Murray Island, I had a good deal of difficulty in determining the existence of a word for colour. In Haddon and Ray's Vocabulary "minir" is given this meaning, but this is certainly not correct. Probably "gami" is the nearest approach to such a word.

The names given by natives of Murray did not differ in any important respect; purple and pink were called grundungas, and a few other terms were used which were probably of the same special nature as many of those obtained in Malaita. They differed however in grammatical form.

The names given by Githa (Tasman ket), Master of Murray, were very erotic and may be retained, as they show how easily one might go wrong by trusting to the names given by one individual. Black was called lagimlagim, which was freely translated by another native, Waliaby, as meaning "No, can't see him," and white was called "lagima" also freely translated as "You and me see him." After having been shown yellow-green which was called malakalunga, green was called "malakamalung." meaning "like another kind of sea—another wind," while blue-green was given another name which Waliaby translated freely as "sea with another kind of wind, plenty blow." These instances illustrate very well the liking of these people for similes.

The colour names obtained from natives of Salait did not differ from those of Malaita, and the same was the case with those obtained from a native of Yom Island by Mr Seigmann.

**Derivation of colour names.**

Nearly all the colour names were formed by adding the suffix -nugunung of -deungwung to the name of a natural object. In a few cases in Malaita this termination had become simplified as in mika lunga (white) and kubububunga; rarely in those cases was the full form of the latter given as kubukungunung. Occasionally this shortened form was given for other colours, as in malakunga, wadunga. As already mentioned, names for uncoloured colours were apparently invented for the occasion by adding the usual suffix to the name of some natural object, and once or twice a native omitted the termination and simply gave the name of the object.

The words given by natives of Salait and Yom did not differ from those of Malaita, but the Murray natives gave the shortened form, as in kulakunga, malakunga, kubububunga. Names were only obtained from four individuals, but they

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1 This word is now the only instance of reduplication in Malaita.
all agreed in this respect. They also, however, used the termination gamainga, which was never met with in Malagasy. White was called minkalæ and minkalinga.

Only one Moa man was examined, but as he made use of such terms as blugamalinga, yéblugamalinga and wainisgamalinga for blue, yellow and white, little importance can be attached to his evidence.

The following vocabulary is divided into three parts. The first giving the names in general use. The second gives the names which were used by several individuals and were probably colour names more or less in general use. The third gives the names that were only used by single individuals and were probably made for the occasion.

### COLOUR VOCABULARY

#### Names in general use.

<table>
<thead>
<tr>
<th>Sans of colour</th>
<th>English equivalent</th>
<th>Derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kukkalugamalinga</td>
<td>Red and purple</td>
<td>Keeka, blood</td>
</tr>
<tr>
<td>Marngamalinga</td>
<td>Yellow and orange</td>
<td>Min, yellow ochre</td>
</tr>
<tr>
<td>Blugamalinga</td>
<td>Green and blue</td>
<td>R, gall-bladder and bile</td>
</tr>
<tr>
<td>Blukalugamalinga</td>
<td>Blue and green</td>
<td>Malo, see</td>
</tr>
<tr>
<td>Miskalinga or Narkalinga</td>
<td>White</td>
<td>Mëkabai, spirit</td>
</tr>
<tr>
<td>Kuikalinga</td>
<td>Black</td>
<td>Kebei, choosed, and also night, darkness</td>
</tr>
</tbody>
</table>

#### Names less commonly employed.

<table>
<thead>
<tr>
<th>Sans of colour</th>
<th>English equivalent</th>
<th>Derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paruamasingamalinga</td>
<td>Red and purple</td>
<td>Panuma, red ochre</td>
</tr>
<tr>
<td>Ikukalugamalinga</td>
<td>Purple</td>
<td>Ikuk, mudhue, probably the same as the &quot;Mudhuk&quot; (Dumbliga sappel) of Murray Island</td>
</tr>
<tr>
<td>Daisamalinga</td>
<td>Orange and yellow</td>
<td>Dasuma, yellow ochre</td>
</tr>
<tr>
<td>Wadugamalinga</td>
<td>Orange and yellow</td>
<td>Wua, yellow, reed leaf</td>
</tr>
<tr>
<td>Nogamalinga</td>
<td>Green</td>
<td>Nuo, buff</td>
</tr>
<tr>
<td>Karbhdgamalinga</td>
<td>White</td>
<td>Karbhi, reef heron (Dunleoparda seen, irr.)</td>
</tr>
<tr>
<td>Senugamalinga</td>
<td>White and grey</td>
<td>Seno, a term (Stenias bergii)</td>
</tr>
<tr>
<td>Budugamalinga</td>
<td>Blue and blue</td>
<td>Bud, pigment obtained by crushing coral</td>
</tr>
<tr>
<td>Kukalugamalinga</td>
<td>Black and blue</td>
<td>Ku, kebi and ku.</td>
</tr>
<tr>
<td>Iliugamalinga</td>
<td>Blue and brown</td>
<td>Ila, extreme darkness (&quot;dark altogether, no see nothing&quot;)</td>
</tr>
<tr>
<td>Daluamalinga</td>
<td>Blue and violet</td>
<td>Dalu, water into which &quot;teiu&quot; (mangrove shrubs) had been washed</td>
</tr>
<tr>
<td>Suingamalinga</td>
<td>Used for dark brown</td>
<td>Suingai, a freshwater plant, the under side of the leaf of which is &quot;sukalagingamalinga.&quot;</td>
</tr>
<tr>
<td>Namgamalinga</td>
<td>Used for blue and violet</td>
<td>Nami, umiri</td>
</tr>
</tbody>
</table>
Names only used by one or two individuals.

<table>
<thead>
<tr>
<th>Name of colour</th>
<th>English equivalent</th>
<th>Derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duskygumgumgiga</td>
<td>Yellow-green</td>
<td>Dusky, a wild plant, which, when cooked, is yellow inside.</td>
</tr>
<tr>
<td>Gumakatangumgumgiga</td>
<td>Green</td>
<td>Gum, another kind of tree.</td>
</tr>
<tr>
<td>Wihalagumgumgiga</td>
<td>Blue-green</td>
<td>Blue, a tree from New Guinea.</td>
</tr>
<tr>
<td>Nokbrakamagumgumgiga</td>
<td>Violet</td>
<td>Okra, from the red fruit.</td>
</tr>
<tr>
<td>Girogumgumgiga</td>
<td>Red</td>
<td>Giro, a tree from New Guinea.</td>
</tr>
<tr>
<td>Kordubagumgumgiga</td>
<td>Green</td>
<td>Kordu, a tree with yellow pungent fruit.</td>
</tr>
<tr>
<td>Ladugumgumgiga</td>
<td>Yellow</td>
<td>Ladu, a tree with yellow pungent fruit.</td>
</tr>
<tr>
<td>Kerozredgumgumgiga</td>
<td>Yellow</td>
<td>Keroz, a tree with yellow pungent fruit.</td>
</tr>
<tr>
<td>Kauradgumgumgiga</td>
<td>Yellow</td>
<td>Kaur, a tree with yellow pungent fruit.</td>
</tr>
<tr>
<td>Tutuagumgumgiga</td>
<td>Brown</td>
<td>Tutu, a tree with yellow pungent fruit.</td>
</tr>
<tr>
<td>Wanawaredgumgumgiga</td>
<td>Light brown</td>
<td>Wanawa, a kind of honeycomb.</td>
</tr>
<tr>
<td>Galukurdgumgumgiga</td>
<td>Brown</td>
<td>Galu, a tree from New Guinea, probably brown.</td>
</tr>
<tr>
<td>Wabagumgumgiga</td>
<td>Brown</td>
<td>Wab, a tree from New Guinea, probably brown.</td>
</tr>
<tr>
<td>Dungalbadgumgumgiga</td>
<td>Drab colour</td>
<td>Drab part of a New Guinean tree, aerial root.</td>
</tr>
<tr>
<td>Gualagamuagumgumgiga</td>
<td>Dark grey</td>
<td>Gualagama, stone of which the head of a club is made.</td>
</tr>
<tr>
<td>Kurasdagumgumgiga</td>
<td>Light grey</td>
<td>Kurasu, lime.</td>
</tr>
<tr>
<td>Maugumgumgiga</td>
<td>White</td>
<td>Mai, pearl shell.</td>
</tr>
<tr>
<td>Dandagumgumgiga</td>
<td>Yellow</td>
<td>Dau, a white powder obtained by rubbing a shell on a stone.</td>
</tr>
<tr>
<td>Bonagumgumgiga</td>
<td>Purple</td>
<td>Bone, very also a wild plant.</td>
</tr>
<tr>
<td>Dhunilbagumgumgiga</td>
<td>White</td>
<td>Dhunil, shell ornament.</td>
</tr>
<tr>
<td>Ronilbagumgumgiga</td>
<td>Pink</td>
<td>Ronil, &quot;sea green estates&quot;, a little sea.</td>
</tr>
<tr>
<td>Gumagumgumgiga</td>
<td>Dull yellow</td>
<td>Gum, Camphorhapha butactum, a white pigeon.</td>
</tr>
<tr>
<td>Bagawagumgumgiga</td>
<td>Brown</td>
<td>Bagaw, used in North-West monsoon.</td>
</tr>
<tr>
<td>Bilunagumgumgiga</td>
<td>Brown</td>
<td>Bibila, a pomegranate.</td>
</tr>
<tr>
<td>Wihalagumgumgiga</td>
<td>Light grey</td>
<td>Gel, some kind of earth.</td>
</tr>
<tr>
<td>Shidagumgumgiga</td>
<td>Pale violet</td>
<td>Silk, flax.</td>
</tr>
<tr>
<td>Astalakadgumgumgiga</td>
<td>Orange</td>
<td>Asa, wax.</td>
</tr>
<tr>
<td>Aresilagumgumgiga</td>
<td>Reddish brown</td>
<td>Basu, wood which, if chewed, gives the saliva this colour.</td>
</tr>
</tbody>
</table>

Other names were also given to individual weeds or plants of which I could not find the derivation; such are banzandgumgumgiga, pale green; sarijgumgumgiga, brown; griagumgumgiga, blue-green; biliagumgumgiga, white; karandagumgiga, yellow; budagumgumgiga, blue-green; lodgumgumgiga, brown; used for pale green and violet weeds; pagoramgumgiga and standgumgumgiga, brown.

One man, Papi, used several names without the usual suffix: he called blue-green "piyawaw," meaning fresh water when nearly dried up; white was called "moi-
A name for red is derived from blood, and the most usual name for green from bile, while names for yellow are derived from ochre, though in Murray Island the word with this derivation was much less common than that derived from turmeric. We saw that in Murray Island there was a tendency to name blues and greens after the sea (karangmangan, sea-green, and karangkagalo, sea-black), and in the Western Tribe a definite name for these colours derived from the word for "sea" has become established. It is noteworthy that the sea, rather than the sky, should have been the source of the word for blue.

The derivation of the word for red from blood is very common and is found among other instances in several Melanesian languages (Duke of York Island1, Solomon Islands, etc.). The derivation of the word for yellow from turmeric is also met with in Melanesia1.

The usual words for green both in Murray Island and in Maloing were derived from the names for bile and the gall-bladder, and they referred especially in this connection to the gall-bladder of the turtle. This organ has a very brilliant deep-green colour which might well have excited the interest of the natives for its intrinsic qualities, but this organ was interesting in a more practical way. In the Western Tribe, if the gall-bladder of the shell turtle were injured during the operation of cutting up, so that bile ran out, the whole animal had to be thrown away, while in the case of the green turtle all those parts touched by the bile had to be rejected1.

1 Cooper's Melanesian Languages, p. 87.
2 Woodward's Naturalist among the Heathenists, 1858, and Guppy's The Solomon Isles and their Inhabitants, 1887, p. 123.
3 Cf. Oldricopis.
4 I do not know whether any similar custom existed in Murray Island.
It was probably on account of its practical rather than its aesthetic interest that bile became the source of the name for green.

It is an interesting fact that bile is the source of colour names in other parts of the world. Our own words for “gill” and “yellow” are closely connected, and the same is the case in other languages. Alquist found that the Chukchea used a word for yellow and green (also for blue) “dilk” which meant bile. Kischhoff states that the word used by the Samoyede for green and blue, viz. “padnaha,” is derived from padina, bile; and he quotes Bodenst the Vegvisars call green and yellow “vorsen orpe,” vorsen being the word for bile. It would be interesting if among those closely related Asiatic peoples, who derive their words for green in the same way, there should be found to be any customs relating to this substance similar to those existing in Torres Straits. A word used by some of the Eskimo for yellow has also the same derivation.1

In both tribes of Torres Straits the words for purple and pink were derived from one of the Apiaceae. In Murray Island we obtained a specimen of “eroko,” and though we were unable to obtain specimens in the Western Tribe there was little doubt that the “irik” of Malauioa, and the “gus” of Muruag were of the same or closely allied species, viz. Dohadella spinula, Martyn (D. El是要npi, Cav.), which is common all round N.E. Australia. It is interesting that the name for purple should be derived from the secretion of a mollusc, as was that of the Phoenix, although murex and eroko belong to widely separated divisions of the group.2

One of the most interesting features of the Malauioa vocabulary is the existence of a large number of special names together with a few well-established names for the chief colours. Though it seemed to me that many of those special names were derived on the spur of the moment, the fact that this was done so readily and by several individuals independently of one another, may be taken as evidence that it was a recognised usage of the language. The words in question were formed in exactly the same way as those in common use, and they seem so illustrative very well the method of growth of a colour vocabulary.

The use of words like orange and violet in our own language shows that as we separate and discriminate variations of colour which have previously been merged in some larger class, we most naturally choose the names of natural objects.

There is, however, one striking difference between the English language and those of Torres Straits. On going through the list of objects from which colour names are derived in Murray Island, and Malauioa one finds that nearly all come into the lives of the people in some practical way, either as food, medicine, or as objects used in sorcery. Objects which might have attracted attention on account of their beauty seldom seem to form the basis of colour names. In Murray Island only one of the names used, muschelkorcher, was derived from the name of a flower; while of the large number given to us in Malauioa not one was derived from the name of a flower. This

1 Diet registrierte, Ergebnisse d. Vega-expedition, 1893. Bd. 1, S. 43.
4 According to Withaker the Innuetae use a word for purple derived from the name of a mollusc.
contrasts very strongly with our use of violet, pink, mauve, heliotrope, rose, etc., all derived from the names of flowers. In discussing the derivation of the words for green, I have mentioned that the gall-bladder probably attracted attention, not on account of the brilliance of its colour, but because of its practical importance. I believe that the nature of the colour neocarotin is but one indication of a characteristic feature of the savage mind, viz. a complete lack of any aesthetic interest in nature.

It is a fact, however, that flowers were largely used by the people of Tembesi Straits for personal adornment. The scarlet hibiscus flower was especially popular, but it was not used as the basis of a colour name.

I have earlier suggested (p. 45) that this lack of aesthetic interest may be directly due to under-development of the sensory aspect of normal life. The Malungo colour vocabulary illustrates very well the extensive knowledge which the savage possesses of the concrete things around him and the powers of observation which are associated with this knowledge. Some of the men in Malungo seemed to have some natural object in mind to compare with every shade of colour shown to them, and in the discussions which often ensued it was obvious that most of the natives were intimately acquainted with the objects in question. This intimate acquaintance is also shown by the existence of a definite name for nearly every species of a. mud and plant, and for the individual parts of many animals and plants, for every condition of earth and water, for every feature of the landscape, and for every reef and sandbank of the sea.

I have met with a few references to other examples of extensive colour nomenclature resembling that of Malungo. I have already mentioned Kirchhoff's observations on natives of Queensland. Gatschet¹ states that American Indian tribes have many colour names owing to the tendency to specialization, and Schefold² was inclined to suspect that in German New Guinea there were no generic colour names in the strict sense, but that colours were named by comparison with natural objects.

It is probable that when primitive man began to use names for colours, he used the names of natural objects either simply or modified in some way, and that definite generic terms for colours have evolved out of these. The Malungo vocabulary is a good example of the coexistence of a large number of special names with a few which have become definitely abstract terms for colour.

THE FLY RIVER DISTRICT.

Our stay in the Fly River district was so short that the colour language could not be investigated with the thoroughness which was possible in Murray Island and Malungo. Colour names were, however, obtained by me from fifteen individuals, while names from several others were obtained by Mr. Ray. One man from the island of Paramu and two who came from Mareatta differed slightly from the natives of the island of Kiwai, chiefly in having a different name for red.

² Idem, Bd. xxx. S. 156. 1891.
Red was called dogologog by the majority, source by three, and arimaarina by one man. The Mawatta man said the man from Parana called this colour kopona. People was called dogologog, and also oruaro, arimaarina and ididi. The Parana man and one Mawatta man called this colour kopona, and the other Mawatta man, chridina. Orange was called ogloglogogog by the majority; by others, curao, dogologog, sisa and gungunguver. One Mawatta man called the colour by a name somewhat like agogog, which I wrote gathogoghine; another Mawatta man called it verivert (weig - sandy beach), and the Parana men called it hoshah.

Yellow was called ogloglogogog by nearly all; also gungunguver, sindibin and sisa. Yellow-green was called pori pori, ogloglogogog, esasaro, gungunguver, ididi and tigiro.

Green was called pori pori, oglogog, tigiro, emasaro, ididi, while three called it wibwibwiba (black).

Blue-green was usually called tigiro; also pori pori, ididi, ipwa and wibwibwiba. Blue, wibwibwiba by several; also pori pori and ididi, and by one emasaro. Indigo was called wibwibwiba by most; also pori pori, ididi, ipwa, tigiro, and by one man questioned by Mr Ray, bulubu. Violet was called wibwibwiba, ididi, ipwa, tigiro and pori pori, and by one man tenbemore.

White was called kwake or bokwakeo by nearly all; two called it siswinas and one emasaro.

Black was called wibwibwiba or wibwibwiba by nearly all; also tigiro, wibwibwiba and ipwa, ipwa ipwa. The Mawatta and Parana natives agreed in calling all green and blue papers pori pori, and indigo and violet wibwibwiba.

The wool brought out five different names; the pale green wool was called by two men ogroser, and the pale violet was called kwos by nearly all. Brown was called different names according to their prevailing colour-tone and shade, including dogologog, arimaarina, oglogogogog, ididi, ipwa, sisa, emasaro, gungunguver and wibwibwiba. Sisa of Mawatta was a number of brown panaquas, while Brown of Mawatta used a similar word panaquas for a faint red seen in the tintometer.

In each of the dialects of Kiow and Mawatta there was a very definite name for red, and both dialects had similar names for yellow, while there were other terms occasionally used for red and orange, viz, arimaarina and oruaro. The most definite word for green was pori pori. Blue was most commonly called by the same name as green or black. There were definite names for white and black.

There were other terms to which it is difficult to assign a definite meaning. Sisawic was used for white and for bright colours such as yellow, while pink was called sisia by one man. It seems to have been a term used in the sense of "bright."

Tigiro was applied to black, violet, blue, and green, and almost certainly means "dark."

Emasaro was used for white, yellow, green, and light blue, and probably may be translated "bright" or "light."

II. 9
Ipuapua meant "dirty," and was used for black, violet, indigo, and blue. Udili was used very widely for purple, blue, violet, green, and brown. It may possibly be a similar word to akamkole of Murray Island and may be translated "dull."

Another term used less frequently was gauorogero, for yellow and yellow-green; while the following were only used once or twice: tamatama, violet; agunor, pale green and violet; harumuturumua, blue-green; giatara, violet; tsorochar, used for orange and yellow-green; boongogoro, yellow-green; ennoraoro, indigo. Some of these may not have been colour terms at all, especially those which were not reduplicated.

In addition to ipapua, red, the following terms were only used by Marawata or Pamana natives: hoesa, orange, weriweri, orange drisdris, purple, patapana, brown, and alalii, red.

The colour names in Kirwi were, as in Murray Island, formed by reduplication, and in one instance cangiogogogho, probably by quadruplication as in the case of manamamana in Murray Island. In addition 'um' or 'ama' was added as an adjectival suffix, but this was often omitted, especially by the Kirwi people, and occasionally the reduplication was also omitted.

I was unable to discover the derivation of the names in most common use, viz. digogolof, hoesa, inogogologo, wihuwahua or hokesa. Orange used for red and orange meant "flame." (Note the word aukakadugamalagal once used for red in Mabuag.)

Arinamamua was derived from axiom, blood. Purporea was derived from pore, which probably meant breast. Sinsisite may have been derived from the name of a plant. Tigofo and erimo were said to be names either of special kinds or special parts of the coconut palm.

I was unable to ascertain the existence of an abstract term for colour. One man used the word metwena after each paper in the same way that gimgim was used in Murray Island, and one man questioned by Mr Ray used "manu" in much the same way.

THE CHIEF FEATURES OF THE COLOUR NOMENCLATURE.

On comparing the three colour vocabularies of Torres Straits and the Fly River districts, it will be seen that they resemble each other closely in that in each the words for red and yellow are far more definite and well established than those for other colours. In each there is also a word which is especially used for green, purpeoa in Kirwi, kosekopekope in Murray Island, and bilganunngua in Mabuag, but these words are not used with the unambiguity which is present in the nomenclature for red and yellow. As regards blue, the three languages may be taken as representatives of three stages in the evolution of a nomenclature for this colour. In Kirwi there is no word for blue; many names are called names which mean black, dark, dull or dirty, while other blues are called by the same word which is used for green. In Murray Island there is no proper native term used for blue. Some of the natives, especially the older men, use galoalo, which means black, but the great majority use a term borrowed from English and modified so as to resemble the other members
of their colour vocabulary. Another word, sawi-sawi, is used occasionally for blue and also for green, and in the absence of the borrowed word this might have been used more often.

The language of the Western Tribe of Teres Straits presents a more developed stage in the existence of a word, maludfan-afaga, which is used definitely for blue, but is also used for green. In this language, however, traces of the tendency to confuse blue and black still persist in the use of such words as i mtekaukauku and kububi- 
digadogadounga to denote blue.

In dealing with Australian languages later, we shall meet with instances of a degree of development of colour nomenclature still less developed than that of Kiwai in which only red, black and white seem to have definite, established names.

There are many other languages in stages of development comparable with those of Kiwai, Murray Island and Macuina. The confusion of blue and black is very common. It has been noted in Melanesian language by Stroech ("Now Haukro and New Britain") and by Schelling ("Malaya in the Solomon Islands"); and I have found a distinct tendency to confuse black and blue in nomenclature among natives of Tanna and Lifin (see p. 83). According to Blagdon, the same confusion is found among the Bushmen and Ovaheroes of South Africa, the Hottentots of South Africa, the Indies of Madagascar, the tribes of the Nilger Hills in India and the natives of Borneo. Andrews quotes the same confusion as occurring among the Mpongwe of the Gaboon and the Caribs of South America. Keller found that 90 per cent of the Nubians of the hills called both blue and black "badel," while those of Sankün gave each a different name. The Nubians examined in Germany by Vivien and others also called both blue and black "badel." Allgaier found that the Chukchee gave the same name to dark blue as to black, and Gibb's gives the same peculiarity in the Chinook language, light blue having a different name. The modern Egyptian peasant also uses the same words for black and dark blue.

There are other races who resemble the inhabitants of Murray Island in having borrowed a word for blue from another language. The English word has been borrowed by many African races, often taking the form of "bii." The Macuri use the English word changed into "brom." The Batius of Sumatra use the word "bana," borrowed in a slightly modified form from the Dutch. They are also said to have borrowed the word "bira" from the Malays, but this is probably a modification of the English word. Some races in Borneo are said to use a word "hidjan" borrowed from the Malay, and the Bajaks are said to use a word "samuni" (sky colour) borrowed from Arabic. The Javanese word "mil" is used for green and blue by several Asiatic peoples including the Tamils and Sinhalese.

8 See W. Williams, Dictionary of the New Zealand Language. New Zealand. 1872.
10 Zetlck. f. Ethnol. Bd. i. S. 60. 1890.
ANTHROPOLOGICAL EXPEDITION TO TORRES STRAITS.

The Sunoyos sometimes use the Russian word "sinyoi" for blue. In the Philippine Islands, the words used for green and blue by several tribes, such as the Ilocos, Tagals, and Bisayos, have been borrowed from the Spanish, and one of the Arawaks of South America examined by Kirchhoff also called blue "auri."

The use of the same word for green and blue is very common. Many instances are given by Andrés and Magnes in the papers already cited, and many other instances could be added. It will perhaps be sufficient to mention that one instance occurs so near home as in the Welsh language, in which there is only one word "glas" for both green and blue.

In some languages one finds a word used for both green and blue, and in addition, other words by which those colours may be distinguished. In Mabuiag the case was somewhat different. In this island there were two words, such used for both green and blue, but it seemed as if these words were in process of becoming terms by means of which the two colours could be distinguished.

Another feature which was common to the three languages of Torres Straits and the Fly River was the absence of a word for brown. Brown papers and woods were called red, yellow, gray or black, according to their colour-tone and shade. In Mabuiag names were given to special browns, but it was quite certain that these were not generic terms for brown in the sense in which we use the word. When a number of woods were put together which the Europian would call brown, the natives would not acknowledge that any one term would apply to all or even to any considerable group of them.

The absence of a word for brown appears to be characteristic of very many languages, probably of the great majority of the languages of the world. Among those which I have had an opportunity of investigating, I have found no word for brown in several Australian, Melanesian and Polynesian languages, in Tamil, Eskimo, Welsh and the Arabic of the Egyptian peasant. The absence of a word for brown has been noted in many other races. Bastian notes that the Siamese call brown "dam-deng," meaning "black-red." Kotelnichen found that the Lapps called brown "ischarpa roksel," again meaning "black-red." The Ainu call brown "furimabe," red being fire. Peggion found that of the 57 Cree words examined by him, only two could give a word for brown; one called it moinis, which was also used for black, and the other "casingiinahayêta," mabuyos being used for pink. Gatschet records that a word for brown is absent from several American Indian (Amerind) languages, while in others there may be several terms for this colour. It is possible that, in the latter case, the words used were names for special browns, as in Mabuiag, and were not true generic terms for brown. This may also be the case in other languages, such as Patagonian, Tongan and Arawan, in which names for brown have been recorded.

10 Marine's Troops. 11 Des Australs, B. 294. 1864.
COLOUR VISION.

The records given of the colour names of several parties of Nubians travelling in Germany show how easily mistakes may be made in such a matter. Kirchhoff concluded that "hamashch" was a definite word for brown, while the same and other Nubians examined by Nachtigal and Cohn gave hamishch or hamashch as a word for grey and for dark and impure colours generally, while it was also used for violet.

Schleicher gives "mello" as a word for brown in two Melanesian languages. This is probably the same word as men, which is a common Melanesian term for "red."

The confusion of brown and violet is common. It will be remembered that both occasionally required the same names in Murray Island and in Melanesia. Gutecher notes that the Kalapya Indians of north-west Oregon call violet "tahltah," and brown "palehmvak tahltah," meaning "not quite violet." The Creeks use oakiedall both for violet and dark brown. Kirchhoff notes that the same confusion is still common in German villages, and that when Halle students wearing violet caps are seen, the villagers say "Here come the brownes." Kirchhoff also notes that the middle High German "brau" was used for violet.

There appears to have been no word in Homer's Greek which one can regard as equivalent to brown, and I am indebted to a note from the Rev. H. T. N. Duckworth that the same is true of the Greek spoken by the majority of the inhabitants of Cyprus at the present day. They call dark brown objects "papago," which is the word in common use for black, while other brown objects are called "sizarks," which is also applied to brilliant scarlet.

**COLOURS OF THE RAINBOW.**

In the discussions on the colour vision of the ancients, the descriptions of the rainbow have played an important part.

I was unable in Torres Straits to ask the names of the colours while a rainbow was visible, but a number of natives gave an account of the colours in the rainbow from memory. They first enumerated the colours they saw and picked them out from the series of coloured papers and then gave them in order on a rough drawing. The account given by the younger man was of very little value; some did not think there was any red in the rainbow, and Tapan, an intelligent young man, gave the four colours of the rainbow in order from without inwards as blue-green, yellow-green, yellow, orange. The answers of the elder men were more interesting. Ula saw mammamamamam outside, kokekkak in the middle, and golgole inside; Papi put mammamamamam outside, bancum in the middle, and golgole inside. Jimmy Des put mammamamamam outside, then bancum, then suacuimari (indigo paper), and golgole (black) inside. Buns put mammamamamam outside, then pipi golgole (violet paper), gianing (yellow-green paper),

5 Das Axelrod, S. 166. 1889.

1 An account of the various colours matched to the rainbow in ancient writings is given by Maguire in Die Entwickelung des Farbenwiss. 1919. 1919.
and galegale (indigo paper) inside. Billy Gaaq said he saw five colours; three chief colours, red, indigo, yellow from without inwards, with a very narrow strip of emote outside the red, and a narrow strip of purple inside the yellow. Pasi, on the other hand, only remembered two colours, red outside and blue inside. Kudub gave three colours, red, green and blue, but gave red inside and blue outside. The observations are interesting in one way as showing the degree of accuracy with which the natives can give a description from memory of a natural phenomenon. The failure of the young men is only one among many instances of the loss of the powers of observation of nature which has accompanied contact with civilization. It will be noted that all the men put red in its correct place, except Kudub, who had reversed the natural order. Ulaa's answer was very interesting. This old man had a good colour sense and was a good observer, and yet the only colour he described in the rainbow was red, and he called the rest of the bow white and black. The fact that only one colour is mentioned in a description of the rainbow, as in that given by Homer, is far from showing that only the power of perceiving that colour has been developed.

Several natives in Mabuing made coloured representations of the rainbow for me. Very nearly all drew two rainbows, a big and a small; and on the occasions when I saw a rainbow in Torres Straits, the secondary rainbow was well marked. In no representation, however, were the colours of the small rainbow given as reversed. Giau called the outer part of the rainbow "aria" glittering; then paramadgumungu, red, kubikubina, black, and mudugumungu, yellow. Waria called the outermost part "daiadgumungu" (an unusual word for white), then mudugumungu (yellow); paramadgumungu (red) and nasadgumungu (blue). The descriptions of the others were still more faulty.

I am sorry that I did not examine a larger number of men, and especially of old men, on this subject, as it is an interesting test of the powers of visual observation and memory in addition to its interest in relation to colour vision.

Quantitative Observations.

The observations so far described show that, in spite of the absence or indifference of terms for blue, the colour can be recognized by the Torres Straits islander, while different shades or tints of blue can be distinguished from one another, and the same is true of other races in whose the same defect of colour nomenclature exists. It is, nevertheless, possible that there may be some degree of insensitiveness to this colour, which makes a given blue a darker and a duller colour than it is to European vision, and may help to account for the confusion of the colour with black.

In order to study this question, it seemed desirable to make quantitative observations on the relative degree of sensitiveness to different colours. For this purpose I made use of Lovibond's Tintometer which had been generously lent to the expedition by Mr Lovibond, and I took this opportunity of expressing my thanks to him for his valuable loan. The essential part of this apparatus consists of three series of coloured glasses, red, yellow and blue, very delicately graded so that each forms a series by
means of which one passes from a colour so faint as to be indistinguishable from colourless glass up to a glass of a high degree of saturation. The instrument itself is a tube at the end of which are two square apertures. On looking into the tube one sees two square patches of light, either of which can be given any degree of coloration by placing before one of the apertures a glass from one of the three series. With this instrument I was able to determine the threshold for each of the three colours, measured by the faintest glass of which the colour could be recognized. The top of the instrument was covered with a cardboard screen so that the glasses which were being placed in the instrument should not be seen. The native had not only to say what colour he saw, but also to say which of the two apertures was coloured. I usually began by placing on one side a faint glass, 10 or 20, and gradually increased the intensity till the colour was recognized and then diminished again till the threshold was found. The three colours were given in irregular order. The threshold was determined by finding the glass which could be correctly named four times in five observations, though often more observations were made with a given glass.

The red glasses were always called namanu. Man as soon as their colour was recognized. The yellow glasses were sometimes called "nokopokopok" or "gasagne" as well as "hamba," but as they have a distinctly greenish tinge, I passed them over as correct. European observers often call these glasses green with low strengths. Owing to the fact that babulul had become the general term for blue, there was no in-"nokotok" to the naming of this colour; when it was not recognized, the natives either said that they saw "nokotok" (white) or that the two sides were "okakok" (equal) or "nokokidan" (the same).

The threshold was determined at one sitting. Owing to the influence of fatigue and practice, this was often difficult. For comparative purposes it is, however, important that all observations should be made under conditions as similar as possible, and it seemed better to be content with a rough determination of the threshold at one sitting than to compare the results of one individual in one sitting with those of another individual in two or more sittings. There was the further difficulty that one could never be sure that a native would make observations on a second occasion.

I looked out carefully for signs of fatigue and inattention, and rests of ten or fifteen minutes were taken when necessary. In the table which follows, the thresholds are given in Lovibond's units (omitting the original points), the fainter glasses having the lower numbers. On the left-hand side are given the results for 18 Murray Island men and boys, and on the right-hand side those for 18 English men and boys.

The two parts of the table show a striking difference between the results for

1 In more recent observations, I have found it better to begin with a glass distinctly above the threshold (say 40), as to give a clear idea of the three colours at the beginning and then progressively diminish. This procedure saves time and consequently diminishes the influence of fatigue.

2 One example may be given in detail to show the kind of results with which one was satisfied. Wawakoi first recognized red at 70, yellow at 60, and blue at 180. On going down the series red was recognized 5 times in 6 at 80, 6 times in 7 at 70; yellow was recognized 4 times in 5 at 60, only twice in 5 times at 50; blue was recognized every time at 60, 3 times in 5 at 50, only twice in 5 at 40. Blue 50 was not tried, but if it had been would almost certainly have been recognized at least 4 times in 5, and Wawakoi's threshold was therefore put down at red 70, yellow 60, blue 50.
## Table IV

<table>
<thead>
<tr>
<th></th>
<th>Murray Island</th>
<th>English</th>
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</thead>
<tbody>
<tr>
<td><strong>NAME</strong></td>
<td><strong>AED</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>Ulal</td>
<td>55-09</td>
<td>10</td>
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<tr>
<td>Wondga</td>
<td>45-59</td>
<td>25</td>
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<td>Post</td>
<td>40-45</td>
<td>10</td>
</tr>
<tr>
<td>Kajga</td>
<td>35-40</td>
<td>20</td>
</tr>
<tr>
<td>Deha Wall</td>
<td>35-40</td>
<td>25</td>
</tr>
<tr>
<td>Jimmy Walla</td>
<td>25-30</td>
<td>20</td>
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<tr>
<td>Lako</td>
<td>25-30</td>
<td>25</td>
</tr>
<tr>
<td>Meiti</td>
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<td>15</td>
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<tr>
<td>Tapan</td>
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<td>15</td>
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<tr>
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<td>Barch</td>
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<td>Charlie Pat</td>
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<tr>
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<td>Nenai</td>
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<tr>
<td>Jimmy Durai</td>
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</tr>
<tr>
<td>Sailor</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

| Average     | 222         | 32/6  | 65/9  | Average | 21/7    | 22/6  | 60/4  |
| Average, omitting Sailor | 176 | 28/5 | 60/9  |         | 21/7    | 22/6  | 60/4  |
| Maximum     | 49          | 50    | 100   | Maximum | 100     | 60    | 80    |
| Minimum     | 5           | 10    | 30    | Minimum | 10      | 4     | 15    |
| M.V.        | 7/60        | 9/71  | 10/5  | M.V.    | 22/6    | 8/71  | 15/43 |
| M.V. A.     | -485        | 306   | 375   | M.V. A. | -7/16   | 305   | 415   |
the Papuan and English observers. (In taking the Murray average it is more satisfactory to exclude Suidor’s observations. Though an intelligent boy, he was only able to recognize the colours when much stronger than the other natives. I have had exactly similar results in testing Europeans in too strong a light, and I think it probable that his defective observations were due to a slight degree of photophobia.) The Murray Islander recognizes red most easily, then yellow, while blue is only recognized when of considerably greater strength. The English observer, on the contrary, recognizes yellow most readily, while the figures for red and blue do not differ greatly from one another. The results tend to show that the Murray Islander is relatively rather more sensitive to red than the Englishman, and distinctively less sensitive to blue. Another striking difference between the two sets of results is that the Murray individuals conform more nearly to one type and vary less from one another than do English observers. In only two cases, Keige and Jimmy Dauar, was yellow recognized at a lower unit than red, and in no single case was blue recognized at a lower unit than red or yellow, while in nearly all cases the threshold for blue was much higher than that for the other colours.

The figures for the English observers show more variation. The majority resemble the average results in showing comparatively small differences for the three colours. A few observers had a high threshold for blue comparable with that of the Papuan, while others gave figures which are wholly unrepresented in the Murray Island table, red having a much higher threshold than the other colours.

The extent to which the different individuals of the two groups deviated from the average is shown by the mean variation, M.V., given in the last line but one of Table IV. It will be seen that there is a rough correspondence between the amount of the variation and the degree of sensitiveness which is especially clear in the case of the Murray Island figures.

In order to compare the degree of variability in the two sets of observers, it is perhaps most satisfactory to take the mean variation in its relation to the average. I have therefore given in the bottom line of Table IV, the figures expressing this relation, the M.V. for red in Murray Island being 405 per cent. of the average and so on. If the figures be taken as the measure of the variability of the two groups, it will be seen that there is less variation among the Murray Islanders for all colours than among the English observers, the difference being very great in the case of red.

This large variation for red in the English observers is due to the presence of a few individuals exceptionally insensitive to this colour. Two of these (F. R. and A. L.) were also insensitive to blue, but the other two individuals (E. H. and A. E. T.) had probably some degree of weakness of the red-green sense, though not sufficiently pronounced to prevent them from passing the ordinary tests for this condition. The fact that such individuals were not found among the Murray Island natives may be taken as additional evidence that red-green blindness was absent or extremely rare among these people. In addition to the individuals given in Table IV, I tested others in whose behaviour with Holmgren’s wools there was anything suspicious and was able to satisfy myself that they could distinguish red at low values, even when for any reason I was
unable to make the complete examination which would have allowed me to include
them in Table IV. I may mention here that the behaviour of a definitely red-green
blind individual with Lovibond's tintometer is quite characteristic; the red and blue
glasses are confused with one another, even when of considerable strength, and the
determination of the thresholds for red and blue is quite impossible. Individuals with
weakness of the red-green sense distinguish strongly-coloured glasses but confuse red
and blue as soon as they are shown faintly-coloured glasses.

I also attempted to compare the relative sensitivity of the natives to the three
colours of the tintometer by determining the just perceptible difference for each. A
glass was placed in one aperture and a slightly stronger or slightly weaker glass of
the same colour in the other aperture with the object of finding the smallest difference
of colour that could be recognized. Observations were made on a few individuals but
were discontinued owing to the difficulty of ascertaining whether the natives distin-
guished the difference of colour or merely the difference in brightness. It is quite
possible that an individual who was insensitive to blue might yet successfully dis-
tinguish two blue glasses by the difference in the darkening of the two apertures.
It seemed that any results obtained would be inconclusive. The observations were,
however, interesting in showing that, under favourable circumstances, the psycho-
physical method of "just perceptible difference" is one which could perfectly well be
used in investigations on these natives.

Another method with which I tried to compare the relative sensitivity to red and
blue and other colours was that of determining the distance at which a small patch
of colour could be seen and its colour recognized. I used patches of Rothe's papers
of two square on a white ground. The observations were made in the same place
and under the same conditions as those employed in testing visual acuity. It was
found that red was perceived at a much greater distance than other colours, while
a blue was not distinguished from a black patch till quite close to the observer.
Other colours occupied an intermediate position. The same result is, however, obtained
with Europeans, especially when the blue patch is placed on a white ground; the blue
then being very much darkened by contrast, and using the same test on Europeans
I have found almost as great a difference between the distances at which red and
blue are recognized.

Most of the Murray Islanders could recognize red at 15 metres, and one man,
Maako (visual acuity 12 by the E method), was right every time at 18 metres, and at
22 metres recognized red seven times in ten. The same man at first confused blue
and black at two metres, but after having distinguished them at this distance was
able to distinguish them at five metres, possibly, however, owing to their difference in
brightness. Others were able to distinguish blue and black and blue and green only
at distances of two or three or four metres.

Owing to the influence of contrast and the difference of brightness of different
colours, the test as I employed it, was very unsatisfactory and I do not attach much

1 The confusion of the red and blue glasses is due to the fact that the red glasses in Lovibond's tintometer
are distinctly bluish, and the red-green blind individual probably sees both sets of glasses blue.
COLOUR VISION.

importance to these results. They agree, however, with the tintometer test in showing a high degree of sensitiveness to red.

So far as I have been able to find, this test is the only one which has been previously used for quantititative observations on non-European races. In 1879, Collins made observations on four Natives in Breslan, and found very slight differences in the distances at which small patches of red, yellow, green and blue paper could be recognized. His observations differed from mine in that the coloured patches were placed on a black ground. The nature of the background is always a great difficulty in observations of this kind, for one may name a colour correctly, not because one sees the colour, but because one recognizes how far it differs from the background in brightness. A suitable form of the test for ethnographical purposes has yet to be devised.

Webster Fox has also made some observations on American Indians (Amerincans). He found that they recognized patches of coloured paper 1 mm. square at one-third greater distances than white men, but he does not mention whether there was any difference in the results for different colours.

Rankes also tested the natives of the Bukami and Tsumai tribes in Brazil with Wolff's colour-points and found that one could distinguish the colours at 27 metres. Rankes's own distance being 20 metres, but nothing is said of any difference in the distances for different colours.

The methods which I employed to make quantititative observations were the best that I could devise with the means at my disposal. The unsatisfactory feature of the test with the tintometer is the impurity of the glasses. It is possible that with pure spectral colours, the deficiency for blue would have been even more marked than I found it. When I found that the colour vision of the natives in Murray Island presented so many features of interest, I wrote to Queensland for some kind of spectral apparatus, but, owing to the slowness of communication in that part of the world, I was unable to get anything in time. It would however, be far from easy to devise a practical test with spectral colours which could be employed so as to obtain a definite result in a short time, as can be done with Lorrined's tintometer.

COLOUR VISION OF THE PERIPHERAL RETINA.

I did not take a perimcter to Terres Straits, and for work on indirect vision, I was obliged to be content with comparatively rough observations by means of patches of colour upon black cards. I used the four cards supplied for the purpose in the Milton-Burley set of pseudoptics, supplemented by two others with orange and purple patches of the same size. I sat directly in front of the native with my face towards the best illumination, so that the cards should be well and regularly illuminated. The native closed one eye and with the other fixed the root of my nose, so that I was

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3 *Correspondent-Blatt d. deutn. Zeitschr. f. Anthropol.,* etc. **Pr.** S. 118. 1897.
Anthropological Expedition to Torres Straits.

easily able to detect any departure from accurate fixation. I then gradually brought the disc at arm's length from outside the native's field of vision, up to the point of fixation, noting the point at which the colour was first named, and in those cases in which it was first named incorrectly, the point at which the colour was correctly recognized. When most colours are passed from periphery to centre of the retina, they may be observed to undergo apparent changes of colour tone, all colours containing yellow or blue components being seen as yellow or blue in the periphery, while the true colours are only recognized when approaching the centre of the field. I was able to determine roughly the points at which the four colours, red, yellow, green and blue, were first recognized, while the natives also in many cases observed changes of colour tone which agreed with those observed by Europeans.

In the absence of a perimeter, I did not attempt to make any quantitative observations, but the rough method brought out several interesting features. The observations are given below in a tabular form; I have only said that the field for one colour was larger than another when the difference was obvious; if accurate measurements had been made, there is no doubt that there would have been minor differences in the limits. Each colour was tried five times. It, Y, G and B are used for fields for red, yellow, green and blue respectively. In most cases fixation was good, and was well kept up throughout.

As regards the limits for the different colours, the most obvious result is that there was comparatively little difference in the sizes of the fields for red, yellow and blue, but blue tended to be the largest of the three, and in some cases blue was recognized very distinctly outside the limit for red, while in no single case was red seen outside blue. The field for green was, however, in nearly all cases obviously smaller than those for the other colours. The difference was so striking as to leave no doubt whatever; in many cases the other colour would be recognized at 30 to 60 degrees from the centre, while green was not named correctly till within a few degrees of the point of fixation. The absolute size of the fields depends so much on illumination and other factors that little importance can be attached to any observations on this head.

In a few individuals, especially Jimmy Riko, the fields for blue were very large, as large as in Europeans, but the general impression left on my mind was that the colour fields were distinctly smaller than in Europeans, especially considering the fact that the illumination was very good. It must be remembered, however, that the observations were probably not easy for the natives, and that the attention devoted to keeping up accurate fixation may have interfered with their power of observation. It may be noted that in those in whom I was unable to detect any difference in the sizes of the colour fields, the fields were all very small. The large size of the field for red is not in agreement with what is found among Europeans. In the latter it is found that there is a close agreement in the size of the fields for red and green, both being smaller than those for blue and yellow. This agreement has been found to be exact when the colours are of equal intensity and saturation. It is known, however, that the trait at which a colour is recognized depends on its brightness, and that, if sufficiently bright, all colours are recognized to the extreme limits of the fields of vision. We have seen that there is reason to believe that red is to these people a relatively
<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Fixation</th>
<th>Night eye</th>
<th>Left eye</th>
<th>Change in colour tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>50-55</td>
<td>Not good</td>
<td>R and B about the same size; G very small</td>
<td>B very large, distinctly larger than R and Y; and it about the same size; G smaller</td>
<td>Green called 'bambam'; same every day. Purple called 'halihina' blue almost all the time in ten</td>
</tr>
<tr>
<td>Tbil</td>
<td>45-50</td>
<td>Very good</td>
<td>Plauchet. No marked difference between R, Y and G</td>
<td>B very large, distinctly larger than R, Y and G about the same size; G smaller</td>
<td></td>
</tr>
<tr>
<td>Saas</td>
<td>45-50</td>
<td>Good</td>
<td>R, Y and B same size; G smaller</td>
<td>No appreciable difference. Once blue distinctly outside red</td>
<td></td>
</tr>
<tr>
<td>Puri</td>
<td>40-45</td>
<td>Good</td>
<td>R, Y, B about the same size; G much smaller</td>
<td>R, Y, B same size, possibly R larger, G much smaller</td>
<td>G twice called bambam in periphery before its correct colour was seen</td>
</tr>
<tr>
<td>Orote</td>
<td>35-40</td>
<td>Very good</td>
<td>No marked difference; possibly G and Y smaller than R and B</td>
<td>No appreciable difference</td>
<td>G once called kinsil-kian in periphery</td>
</tr>
<tr>
<td>Gomor</td>
<td>30-40</td>
<td>Fair</td>
<td>Little difference</td>
<td>R, R, Y equal; G smaller</td>
<td>Two called 'bambam' in periphery</td>
</tr>
<tr>
<td>Maze</td>
<td>30-35</td>
<td>Good</td>
<td>No obvious difference; perhaps B largest and G smallest</td>
<td>do</td>
<td>R once called 'bambam' in periphery and twice called kinsil-kian</td>
</tr>
<tr>
<td>Nikvil</td>
<td>30-30</td>
<td>Good</td>
<td>No difference. Fields very small</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Gisi</td>
<td>25-30</td>
<td>Fair</td>
<td>No difference; R, B, G smaller</td>
<td>do</td>
<td>G twice called 'bambam' and purlpe called 'halihina' in periphery</td>
</tr>
<tr>
<td>Kapun</td>
<td>30-35</td>
<td>Good</td>
<td>No appreciable difference</td>
<td>R distinctly smaller; G much smaller</td>
<td>Called purple and Y 'halihina' and G 'kinsil-kian'</td>
</tr>
<tr>
<td>Trasa</td>
<td>18</td>
<td>Good</td>
<td>No difference. Fields very small</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Masba</td>
<td>18</td>
<td>Good</td>
<td>Little difference; possibly R largest and G smallest</td>
<td>B distinctly larger than R</td>
<td>Twice called purple 'bambam'; for a considerable distance before recognizing it as 'kinsil-kian'</td>
</tr>
<tr>
<td>Berh</td>
<td>17</td>
<td>Good</td>
<td>B and Y very large; R slightly smaller; G much smaller</td>
<td>No appreciable difference R, Y and B; G smaller</td>
<td>Purple called 'halihina' in periphery before recognizing it as 'kinsil-kian'</td>
</tr>
<tr>
<td>Charlie</td>
<td>17</td>
<td>Fair</td>
<td>No marked difference. Perhaps B largest and G smallest</td>
<td>Y and B distinctly larger than R and G</td>
<td>G three times called 'bambam' before being seen as 'kansil-kian'. After this called 'bambam in periphery'</td>
</tr>
<tr>
<td>Jimmy Bar</td>
<td>13</td>
<td>Good</td>
<td>Little difference, but B largest and G smallest</td>
<td>do</td>
<td>Good R, Y, and G called once 'bambam' in periphery</td>
</tr>
<tr>
<td>Ten (Tom)</td>
<td>11</td>
<td>Good</td>
<td>B much larger than R and G</td>
<td>B slightly larger than R</td>
<td>Purple once called 'pips' (pigs) in periphery</td>
</tr>
<tr>
<td>Salve</td>
<td>11</td>
<td>Good</td>
<td>B largest. R and G distinctly smaller; Y very small</td>
<td>do</td>
<td>Yellow called 'pips'</td>
</tr>
<tr>
<td>Jimmy Dooer</td>
<td>10</td>
<td>Bad</td>
<td>R, Y, B equal; G smaller</td>
<td>do</td>
<td></td>
</tr>
</tbody>
</table>
briiter colour than it is to the European eye, and it is possible that the relatively large fields may be referred to this cause. The greater definiteness and certainty in naming red may also have contributed to increase the apparent size of its field.

The other most noteworthy result of these observations was the large size of the blue field, notwithstanding the apparent insensitivity to this colour as shown by other tests. This point will be more fully considered presently. The approximate agreement of the fields for yellow and blue is in accordance with European vision.

A certain number of natives observed distinct changes in colour as the patches were passed from periphery to centre of their fields of vision. The green used had a distinct yellow tinge, and six natives called it "bamboa" (yellow) in the periphery, most more than once recognizing it as green only when much nearer the fixation point. The red was called yellow twice (by Mabo and Jimmy珏, both good and intelligent observers). The purple test was called blue in the periphery by five natives, who only recognized it as manmanamana or kiamikam when nearer the centre.

The orange test was of little use, since both orange and yellow (the colour in which orange should appear in the periphery) have the same Murray Island equivalent, viz., bamboa. It is, however, important that orange was never once called manmanamana in the periphery.

The changes of colour observed agree in general with the normal behaviour of European eyes, and they afford important evidence that in Murray Island, as in Europe, the fields for green and red were smaller than those for yellow and blue. On the other hand, two good observers, Mabo and Ovoto, called blue "kiamikam" (pink) in the periphery; this only happened, however, once in each case. Several natives tended to answer wildly after they had found that they had been wrong once or twice, and I have often noticed the same behaviour in Europeans; after having named several colours wrongly people lose confidence in their powers of observation and name the colours almost at random; thus Charlie Paul, after having once called green "bamboa," called yellow "nakapauapau," green. Tapuna's answers were especially wild, but his knowledge of native nomenclature was very defective and he made mistakes in naming, both with coloured papers and with the thermometer; in fact his mistakes were so marked that I took especial pains to examine him several times to assure myself that he was not colour-blind. This observations were especially interesting in regard to change of colour tone. He was an elderly man, who kept up extremely accurate fixation; I was unable at any time to detect the slightest wandering of his eyes. In order not to confuse him, I only moved the purple disc towards the centre till he recognized it as blue, and only after he had five times called purple "mahibumi" did I move it on nearer to the centre, when he called it "kiamikam"; on repeating with the left eye, he again called this colour "mahibusi" four times out of five.

It is known that all colours are seen (at ordinary illumination) as grey in the extreme periphery of the retina. Only two natives, both boys, called any colour grey; one called purple and the other yellow "papi" or grey in the periphery. The fact that this did not happen more often was possibly due to the fact that the natives

1 In my experience in using the same or similar tests on Europeans, red is seen outside green very commonly if the red one was at all bright and intense.
COLORE VISION.

were only on the look-out for colour (in the narrow sense) and did not give an opinion till some definite colour appeared. One of the two boys, Schlie, who called yellow "pips" did so till it was quite close to the fixation point. This boy had a very high threshold with the tintometer, and when tested the first time with Holmgren's woods, he matched the yellow test with almost colourless woods, but when examined a second occasion there was no definite evidence that his colour-sense was defective.

If there was any defect in his colour-sense, it was, however, certainly not of the common type in which red and green are confused, but rather of the type, so rare among Europeans, in which there is confusion between yellow and blue (see p. 31).

Observations on the peripheral colour vision of Nubians travelling in Germany were made by Schöller 1 using Finsler's perimeter. His results agree closely with those gained by my less exact method. He found the field for green smallest, then red and blue in order, that for white being the largest. The different individuals varied from one another, but on the whole the fields were as large or larger than in a European, especially in the temporal direction. Schöller also examined an Indian and a Negro, who gave similar results. He notes the excellent attention and fixation of the Negro as compared with the Nubians, whose power of attention is described as very weak.

Lombroso and Currans 2 examined the visual fields of some individuals from the region of the White Nile, probably Dinkas. Their visual fields for white were large and regular, being much more nearly circular than in Europeans. No fields for colour are given, but it is stated that the distribution of chromatic sensitivity was the same as that of the European eye.

The observations on indirect vision, rough though they were, brought out one point beyond all doubt which appears to be in conflict with the other observations made with the tintometer and coloured woods. There was no doubt that the colour blue was recognized readily, even more readily than other colours. The colour of the patch used was saturated, but if the colour had been relatively dark to the peripheral retina of these people, one would certainly have expected the size of the field to be diminished.

Schöller's more exact observations also show that in another race, presenting much the same defect of nomenclature for blue as existed in Torres Strutts, blue was readily recognized in indirect vision, its limit being outside that for red.

The most ready way of reconciling the two sets of observations is to suppose that the defective sensitivity to blue is due chiefly, or altogether, to the influence of the macula lutea. It is well known that owing to the yellow-red pigmentation of the region of direct vision, blue and green rays are absorbed more strongly than in the extra-macular regions of the retina. On this account blue is a less intense colour to the macular region of the normal eye than it is to the extra-macular region.

There is, so far as I know, no actual evidence that the yellow pigmentation of the macula is greater in black-skinned people than in the Caucasian races, but there is very little doubt that this must be the case. If so, the absorption of green and

blue rays would be greater than in the European eye and may account for the relative insensitivity to blue.

The patch of colour shown in the tintometer was 13 mm. in diameter at a distance of 22 cm. from the eye, i.e. with steady and direct fixation, the image of the patch would fall wholly within the macular region. During movements of the eye and when looking at the adjoining patch, the extra-macular regions of the retina would be stimulated, but the influence of the macular pigment in direct fixation would probably be of most importance.

If this view is correct the defective sensitiveness for blue is to be regarded as a function of the pigmentation rather than of the primitives of the Papuan visual organ. It is interesting in this connection that when Virchow was examining pupils in Berlin in 1878, he found that the difficulties in naming blue and green became very much less if he used large sheets of coloured paper instead of small patches.

COLOUR CONTRAST.

There was no doubt that the natives could see contrast colours, but I believe that they saw them less vividly than the average European. I tested them with rotating discs on the colour top and with Meyer's experiment. By the former method (wheel contrast) they only saw red as a contrast colour. On an orange disc one man saw the (objectively) grey rings as "kebe balabala," but with this exception the grey rings on red, yellow and blue backgrounds were described as pīpi (grey), gentleina (black), kalakakok (white) or mamoama (white).

With the green disc, on the other hand, the majority saw the objectively grey rings as mamoama, kebe mamoama, or daatu mamoama. Some saw the contrast colour immediately and spontaneously, others only after being pressed to say if they saw any other colour besides that of the background. Others failed to see any colouration and described the grey rings as pīpi or kalakakok. The fact that red was more readily seen than other colours in wheel contrast agrees with what is usually found among Europeans.

Meyer's experiment, in which grey paper on a coloured ground is covered with thin tissue paper, gave more definite results. The grey patch on a green ground covered with tissue paper was called mamoama by all readily. On a blue ground, the objectively grey patch was called "bamboam," by all except one man (Katab), who described the colour as "aumani," and two boys who called it "kebe kalakakok." Green as a contrast colour was much more delicate; some saw it, but most described the grey patch on a red ground as colourless; one man called it "aumani" (bright), and one as "lohegul" usually used for grey. The patch on a yellow ground was called by nearly all "golegole." Only one man called it first "golegole" and later "balabala." Since "golegole" was often used for blue, this does not necessarily show that they did not see the colour, but they were all in the habit of calling blue.

“babalulu” when talking to me, and I have little doubt that they would have used the word if they had recognized a blue colour.

A grey patch on a black ground was called “kakakakek” or “pipi,” while on a white ground all agreed in calling the same grey “gogogola.”

Meyer’s experiment showed very clearly that the natives were able to recognize differences of apparent brightness due to contrast and also that they could see red and yellow fairly readily as contrast colours. Green was seen less readily, and it was doubtful whether blue was seen at all by the majority. Considering the capacity of the natives, however, as observers and the readiness with which they distinguished faint reds and yellows in the tintometer, the observations seem to indicate that contrast colours were not very pronounced for them, and were probably less vivid than for the average European.

The conclusion was very strongly corroborated by one result of the observations with the tintometer. When working with this instrument with Europeans to determine the threshold of colour in the way already described, I have continually met with instances where the aperture in which there is no glass has appeared in the contrast colour complementary to that of the aperture in which a coloured glass has been placed. Over and over again the contrast colour has been seen when the objective colour of the glass has not been recognized.

Thus to give a few instances, A. E. T. in 12 observations with the yellow glass in one aperture, saw the opposite aperture blue every time, although he only recognized the objective yellow six times; W. F. in ten observations with a blue glass saw the opposite aperture yellow four times while only recognizing blue three times; A. L. in ten observations with a red glass saw the opposite aperture green nine times while only recognizing the red colour five times. In many of these and other instances the subjective contrast colour was seen when the objective colour failed to be recognized.

The behaviour in Murray Island was very different. I was on the look out for this peculiarity and yet in many hundred observations, a colour was only seen to be seen on the wrong side 15 times. No less than six of these occurred with a blue glass when the opposite aperture was called “babalulu”; in one case the opposite aperture was called red. The aperture opposite the red glass was called “babalulu” four times and “gogogola” once; opposite a yellow glass, blue was seen twice, and red once.

Some of these were no doubt accidental, but it is interesting that the instance which occurred most often was when the objective colour was blue to which they seemed so insensitive.

There is just a possibility that the natives with their sharp powers of observation were always able to detect in which aperture a glass had been placed and limited their observation to this aperture, but it is by no means easy to do this, and I have very little doubt that the observations with the tintometer show that the natives perceived contrast colours less readily than the average European.
Two methods were employed to ascertain if negative or complementary after-images could be seen.

In one a patch of coloured paper on a grey ground was removed after 10 to 20 seconds fixation, when the complementary colour would be seen on the grey background. In the other, which may be called the indirect method, a grey patch was fixed on a coloured background from 10 to 20 seconds, and then a grey surface was superposed on the whole, when an after-image of the original patch would be seen in the same colour as the original background while the surrounding part would be seen in the colour complementary to the background. The patches used in both cases were in zigzag form, and the native pointed with a pencil to the place where he saw the after-image colour.

In all cases in which the natives said that they saw a colour after the original stimulus had been removed, this was described as being of the colour complementary to the original. Red here again was most readily seen, and blue was doubtful.

Of the two methods, there was no doubt that the after-image was seen most readily by the second or indirect method. Several men who failed to see an after-image at all by the direct method, saw it well by the indirect method. In this second method a coloured after-image is seen in an area of the visual field, which has only been objectively stimulated by white light, and may be regarded as an after-image of the contact colour. It is a mixed phenomenon of after-image and contrast (or, as they may be called, "temporal and spatial induction").

Preference for Colour.

I endeavoured to find which colours the natives preferred by asking them to pick out the papers they liked best. In most cases they were told to choose the three papers they preferred, while in some cases I made them go through the whole set of papers in the order of preference. I felt less confidence in this than in almost any other of my investigations owing to the absence of any means of finding out whether they really understood what I wanted. I have omitted the answers of several which seemed doubtful.

One of those answers was distinctly interesting from another point of view. One man, Papi, when asked to give me the papers in the order in which he liked them, gave them in almost exactly the same order as that in which I had previously given them to him when ascertaining his names for colours. It was an interesting example of the good observation and memory of the natives, though unsatisfactory from the point of view which I had in mind.

I found it interesting to get several natives together and let them discuss the subject of preference among themselves. They would usually get very interested, and, after a discussion often lasting for some time, would give me their conclusions. They may, of course, have been discussing something else; but, except in a few cases, they gave me the idea of having thoroughly understood. It is interesting in these cases
that they never finished by agreeing with one another, but each gave his independent opinion. This also occurred in two cases in which a man and his wife gave their opinions; thus after a friendly discussion between Debo Wali, our servant, and Kaima, his wife, Debo Wali chose red, violet, and purple in order, while Kaima chose purple, orange, red. Of another married pair, Wag chose purple, indigo and yellow, while his wife, Kaimi, chose red, purple, and yellow. 20 men and two boys were questioned. Among these red was distinctly the favourite, having 9 firsts, 5 seconds, and 1 third; purple, 2 firsts, 5 seconds, and 3 thirds; indigo had 4 firsts, 5 seconds, and 1 third; black, 1 first, 4 seconds, and 3 thirds; yellow, 2 firsts, 3 seconds, and 2 thirds; while the green, blue and violet were rarely chosen.

Among the women, red and purple were the most popular, with 4 firsts, 3 seconds, and 2 thirds, while yellow and indigo were each chosen twice; black had the third place once, and green was not chosen at all.

As I have already said, these results were unsatisfactory, in that I had no means of testing how far they were reliable till it occurred to me to study the preference for colour in another way. On several Sundays I noted down the colours worn by the people in church. This was most easily done in the case of the men. The orthodox Sunday costume of the men in the absence of a coat consisted of a singlet and pair of trousers with scarves round the neck and waist. These scarves were purely in the nature of ornament, and should be a good indication of the preference of colour. I came out very clearly that black was the most popular. On three Sundays the numbers for the neck scarves were: black 21, and red 8; green, 4; blue, 2; for the waistbands: 7 black, 4 red, 6 pink, 8 green, 4 blue. Those who did not wear trousers were检索的，which were most often red. I did not note any black; 9 were red, 2 pink, 4 white, 1 blue, and 2 yellow. On other occasions when I did not keep a record I noted that black scarves were clearly the most numerous.

It was much more difficult to keep a record of the colours in the case of the women, owing to their dresses having more mixture of colour, but there was a very obvious predominance of red. On two Sundays I noted 28 red dresses and 3 pink, while many white or whish dresses had red edges, etc. Blue was the next most common colour, 16 being noted, while of yellow, 8 were noted. There was a marked absence of green.

I was inclined to regard the frequency of black among the papers chosen by the men as a very doubtful feature, and as indicating that they did not understand properly what was wanted, but when I found that black was so predominant in their personal adornment, it became no longer unsatisfactory, and may be taken as an indication of a real liking for this colour (or absence of colour). It is quite possible that the preference for black may have been a passing fashion, for the savage is as much under the sway of changing fashion as his European brethren. In any case I have no doubt that the liking for black is quite modern, and is due to European influence. It is possible that the frequency with which this colour was worn was due to the introduction of the idea of wearing black for mourning, but unfortunately I did not inquire into this.

1 These results were in agreement with many others, showing that these natives have a very considerable amount of independence of opinion and by no means follow blindly the opinion expressed by others.
point. The blues worn were saturated, and closely resembled in colour the indigo paper which so many preferred. The undisputed popularity of this colour may seem to be in conflict with the idea I have advanced that blue was a dull dark colour to these people, but when one also takes into account the popularity of black, no great importance can be attached to this point.

The two methods differed very distinctly in respect of green; the green papers were hardly ever chosen, while green was not at all unpopular as an adornment among the men. The difference is, however, readily explainable: the green ties and sashes worn were of a very brilliant, vivid colour, while the three green papers of Roder's set are very dull and unsaturated. Indeed the chief fact shown by the two methods, in addition to the popularity of black, was that a colour must be brilliant and saturated to be popular, while among saturated colours red easily had the first place, followed by blue, while yellow and green were distinctly less favoured.

When two or more colours were worn together, these were usually fairly harmonious with one another. Complementary colours were commonly worn together, yellow with blue and green with red. Some men from Kiwai, who came one day in hideous red and yellow jerseys, presented a very striking contrast with the Murray Island inhabitants. We took with us from Thursday Island some very unesthetic garments as trade, but none of the natives would look at them.

I tried to make a few observations on the appreciation of colour harmony, giving the natives combinations of different wools and asking which they liked best. There were obviously marked individual differences. When asked whether a yellow wool looked better with a scarlet or with a blue wool, Pasi preferred the latter, while his daughter was quite certain that the former was the prettiest; she, the man certainly seemed to have the better taste. Unfortunately I had not time to make any extended observations on this point, but it is probably one that would be well worth attention.

**Observations on Melanesians and Australians.**

Four men from the Island of Tanna were tested and also three young men who had Tanna fathers and Melanesian mothers. None were colour-blind, the matches with Holmgren's wools being of the same kind as those made by the Torres Straits people, i.e. they tended to confuse blue with green, red with pink, and to match violet with neutral wools. One man, Naui, matched one violet with the pink test in his first trial but on a second occasion was perfectly normal.

The men came from three different districts of Tanna and spoke different dialects. Two of the four men belonged to the Wossi district, one to Kwamena and one to Imagi. The two Wossi men agreed in calling black, tapen 1 or taben; white, tarsun, and red, purple and orange, tarsamur. About the names of the other colours they did not agree; yellow was called tuna, tapul and takulum; green was called tanis, tanini-ta and tana; brown was called tamin; violet was called tapen (black), and takulum; the pale green and violet test wools were called tarsamurangi.

1 The "t" in these words is verbal. "Tapen" means properly "it is black."
(white); leaves were called tapes (black), tapeamatseng (blackish) and taklim, a word used also for violet and yellow. The indigo paper was called mulua by one man and mabom by the other, but the different form of these words suggests that they were not colour names.

The Kwanersman called black, mapita⁴; white, mateta; red, koma; orange, matere; yellow, mateta; blue, mapeta (black) and mabon; indigo, tameta; violet, mabonita; brown, mapita and tameta. It will be noticed that this man used the same word for red as the Weiss Indian. Tameta, used for yellow, green, indigo and brown, is derived from mana, blood, with the Weiss Indian prefix.

The Inungo man called black, mapeta; white, mana; red, lobo⁵; people, monbokkak and mambokkak; orange and yellow, lao and laobokkak; green, moni; blue, monimatsim; indigo, monimamoni; violet, monimabokk; brown, monimabokk; monimatsim; and moni, the last word having been used by the Kwamans man for blue and violet. The vocabulary of this man is remarkable for his free use of qualifying suffixes, red, purple, orange and yellow being all named by some modification of one word while blue, green, and violet were named by some modification of another.

These vocabularies were obtained from too few individuals to be of any great value, but they agree with one another and with the Torres Straits languages in showing confusion between green and blue or between blue, violet and black. In none of the dialects did there appear to be a word for brown.

One native of “Duke of York” Island was tested. His colour vision was perfectly normal but he had left his native island so long that he could not give the “Duke of York,” names for colours with any certainty.

One native of the island of Audioum who was examined had normal colour vision. The names he gave for colours agreed with those which are given by Inglis in his Dictionary of the Analaguese Language, with the exception of those for blue and green. Inglis gives “emilat” for both blue and green; my native gave this name to blue-green, and called the green paper melonik, while the blue paper and wool were called melonik, all being apparently modifications of the same word. Both blue and brown were called macingat, a name also given by Inglis for both these colours.

One man was examined at Rockingham from the small island of Nguna near Sanwich Island in the New Hebrides. He was not colour-blind, his matches with the words being of the Torres Straits type. He called white, idan; black, ibu; red and purple, inkula; yellow, ilbi; green and blue either nghi or sini. Malin was said to mean “dark.” He had been away from his native island for many years and his names must be taken with reserve.

Towards the end of our time in Torres Straits, I tested a man, named Suni, from Lifau in the Loyalty Group, and found that his matches with Holmgren’s words were distinctly indicative of red-green blindness. He matched red with brown; bright green

⁴ The "i" and "a" in this and the following dialect corresponds to the Weiss "i." En-pita means "it is black.
⁵ Colington (Melanesian Lexicon) gives "lobo" as the word for red in several of the Banks’ Islands.

The prefix "i" in verbal; it also means properly "it is white."

See Colington.
with greens; but compared a yellow and a yellowish brown; he matched Holmwood’s pink test-wool with blue and violet; Holmwood’s green test with a salmon coloured wool; yellow was matched normally; blue was matched with violet and pink, and violet was compared with bluish-green wools. The next Lifu man whom I tested was a typical example of red-green blindness and I began to think that I might have come across a colour-blind race. I had unfortunately at this time no other means of testing, so the tintometer had been taken on to Samoak, but I do not think there could be any doubt about the diagnosis.

I was able to examine one more Lifu man in Mahinan but he was perfectly normal. Later I was able to find another Lifu man in Thursday Island and three men in Rockhampton. Two of these were perfectly normal; another was colour-blind, or at least had considerable weakness of the red-green sense; he closely compared the pink test with several blues and finally matched it with violet; he also matched violet with pink, and yellow with a yellowish green wool. The matches of the fourth man were unsuspicious, the pink test being compared with a blue wool though no faulty matches were actually made. Mr Schieffelin found another Lifu man on Yami Island who was normal.

Of the eight Lifu natives tested, three were definitely colour-blind while the behaviour of a fourth was distinctly suspicious. When contrasted with the failure to find one case in Torres Straits, this fact is sufficiently striking. The difference certainly cannot be ascribed to any defect in the intelligence of the Lifu people. The natives I examined were certainly more intelligent than the average Torres Straits Islander, and I am inclined to regard them as the most intelligent natives that I came across.

I may also mention that the colour-blind individuals were not related to one another, though one, Sani, and one of the normal natives were first cousins. I was very anxious to find natives of Mare and Van (or Ura), the other two chief islands of the Loyalty group but I was not able to do so. I was able, however, to test one man whose mother was a Mare woman (father Scotch), one boy whose father was a Mare man and one boy whose father was from Ura (mothers Mahinan). The man compared the pink test with a violet wool on two trials, but otherwise his matches were of the Torres Straits type. The boys were both quite normal.

The number of Loyalty Islanders examined was of course too small to allow any definite conclusions to be drawn, but the observations certainly suggest that in this race colour-blindness was fairly common, and that races may exist in which colour-blindness is much more common than it is in European races.

The Loyalty people occupy, in some respects, an exceptional position among Melanesians. Mr S. H. Ray, to whom I am indebted for much information on the subject of Melanesian languages, tells me that the languages of Lifu, of Mare and of parts of New Caledonia have special and peculiar characters. There is also a considerable Polynesian element. It is, therefore, of considerable interest to find that these people appear to be exceptional in the nature of their colour vision, and the possibility is suggested that the examination of the colour sense may, in some cases, be of use in determining the affinities of different races.

The names for colours were obtained from both the normal and the abnormal Lifuans.
COLOUR VISION.

All the natives agreed in calling white, kawia, and black, kaweteke. The normal natives called red, kapula, kaumata, and kanuta. Mada or madra is the word for "black," and mumu is said to be the term for a ripe banana. Kaminiti was used for orange and yellow; yellow was also called kahahi, a word used as well for brown and grey. One man called orange kaminiti, ued or mixed being tarmeric. Greens were called kahakihatu, kahakihah, thilife, and maun. Blue, indigo and violet were called laua, kwetawet (black), kamangu, komang, and munganahau (nearly "munganu"). Brown, were called kahahi, kwetawet (black), kahakihah (hatku — smoker). The word "dita," which was said to be the name of the fur of the flying fox, was also used for brown and by one man was used for nearly all browns. It is the nearest approach which I have found among Melanesians and Polynesians to a word which could be regarded as a generic term for brown, but was only used in this way by one man.

The names were obtained from too few individuals to have much value, but it will be noticed that the tendency to confuse blue and black in nomenclature is distinctly present.

The names given by the colour-blind men tended to confirm the diagnosis of their condition. One called both red and indigo kapula, used by the others for red. Two men called both red and yellow kaweteke, used by the normal individuals for red, and one of these called blue, indigo and violet aguapman, a word not used by any of the normal men but which, Mr. Bay informs me, is usually used for purple.

Eighteen natives of Queensland were tested with Holmgren's wool and their names for colours obtained. Seven of these, examined on Mabuiag, came from the district of Sever Rivers on the east coast of the Gulf of Carpentaria; one came from Red Island; the remaining ten were examined at Rockhampton; eight of these belonged to the Fitzroy river district; another came from the McKenzie river and a boy from Cape York. The Fitzroy natives included two women.

The wool test was carried out with very little difficulty, the natives understanding readily what was required of them. Two men, one in Mabuiag and the other in Rockhampton, spontaneously arranged the wools before them in order of similarity and all took obvious interest in the process of matching. Their matches were of the same kind as those made by the Torres Straits natives. There was no red-green blindness; one man, Kurahana, of Fitzroy, compared for a time a violet with the pink test-wool but refused to match it, and his other matches were quite normal. The same kind of confusion occurred as in Torres Straits; four men were put down as perfectly normal, six put red and pink together, eight confused green and blue, five confused blue and violet, two put very faint pink with violet, most matched wools of very faint saturation with Holmgren's green wool, but all these matches were of the kind that can

1 "Ka" is an adjectival prefix.
2 The term which I have written "ch" was spoken as if it were a very soft sound, like the "ch" in "che" but much softer. Mr. Bay informs me that the missionary uses "i" for this sound. I found the sounds of the local language much more difficult than those of any other Melanesian or Polynesian language of which I had experience and my spelling must be taken with reserve.
3 The use of this word is interesting in that the reddish fur of the flying fox (Pteropus) is tested by the natives of the Loyalty Islands into a word which is used as currency. This is another example of the fact that it is mainly objects of practical importance which give rise to colour names (see p. 68).
be explained by the influence of language while they also point towards some degree of insensitiveness to blue and green as compared with other colours. The two women were very good; one was absolutely normal, while the other only confused blue and green slightly.

The eighteen natives examined spoke several languages and I was not able to examine a sufficient number in any one language to enable me to speak about the colour vocabularies with anything like the confidence that I feel in the case of the Torres Straits languages, but a certain number of points came out so definitely that there can be little doubt about them. There was rather more difficulty in getting the natives to understand that I wanted the names for colours than was experienced with the wool matching; they nearly all gave to their names for paper and calico respectively when I showed them the papers and cloths. The difficulty in this respect was certainly greater than in Torres Straits, but was probably due to their very scanty acquaintance with English.

Three of the Seven Rivers natives agreed in calling red, purple, and orange "it", said to be the word for blood; white, yellow, and the three green papers were called "ya-ya"; black, blue, indigo and violet were called either umma or manara. Two other natives, who both came from the district of Deua, called red ouang or ouangadu, but one of these called it also "iti." Black, blue, indigo and violet were called "uma"; white and pale colours were called "napok"; yellow and green were called ejin by one and ejin or wapok by the other. Ejin was also used by both for dull colours. Browns were called ejin or umma. Most of these natives, who probably spoke dialectical variations of one language, seemed to agree in having only three definite words in their colour vocabulary, viz. iti or ouang for red and colours containing red, yapa or wapok for white and light colours, and umma, or manara, for black and dark colours.

Another native of the Seven Rivers district, Fantangia, who said he came from a place called Boggan on the Daric River, gave altogether different names. He seemed very intelligent and I therefore give his names although they must be taken with all reserve. Red and purple were called ouininta; yellow and green were called talawat; orange was called ouininta and talawat; white, kawat; black and indigo were called ngi or amai; green and blue were called ngadop; violet was called nga and amai and also awiti. The confusion of nomenclature for blue and black was distinctly present but the vocabulary appeared to be more extensive than that of the other natives, though it is of course possible that some of the words were not colour names at all.

The one man from Red Island, Jimmy Matauri, had a fairly extensive vocabulary. Red was called jaka, meaning blood; orange, japa, meaning sunset; yellow, anoua-typta, a flower; green, wewia (a place) or atia (a tree); blue, liping malu or malu; black was called manara and white yapa; browns were called manara. It will be noticed that his names for black and white were the same as those used by many of the Seven Rivers natives on the other side of the peninsula and that his word for red was derived from the word for "blood.

His other colour terms were probably...
of the same nature as those used so often in Makauing and were the names of natural objects suggested to him by the colours.

The eight Fitzroy River natives examined at Rockhampton agreed fairly well in their colour nomenclature; five called red kirin, two others tarir, and one both kirin and tarir; purple was called kirin or tarir by all but one, who called it namru; and to mean blue, orange and yellow were called kalnuor or kalmar/kalnuor by nearly all; green and yellow-green were called kalnuor by several and also guru (black), burn (white), maaalnul, kirpe, and warirwar (one man called red, yellow and green kirin). Blue-green was called kalnuor, maaalnul, guru, and guru-ulaser; blue was called guru (black) by all. Indigo was also called guru by most; one called it “bala,” another ngilfingil, another both ngilin and bulu, while another native, to whom I suggested ngilin as a name, was very obviously pleased with its suitability. Violet was called guru, bulu and kalnuor. All agreed in calling white burn, and black guru.

The native from the McKenzie River, an elderly man, called white bojia; black, mita; red and purple, nima; yellow, narnun; green, wobol and narnun; blue, indigo and violet, mita (black).

It will be noticed that, in addition to definite words for red, white and black, the Fitzroy natives had a name “kalnuor” which they used for yellows and greens; it was also used by one man for violet and does not seem to have been so definite as the word for red. There seems to have been most variation in the names for green, but I was unable to discover the derivation of the various words used. Blue and indigo were called black by the majority; I do not know the meaning of the other word used for those colours, ngilin. Several of the Fitzroy natives who called red kirin, appeared to be wholly unacquainted with the word “tarir,” which was used by others, and this word probably belonged to another dialect, or may possibly not have been a colour name. It will have been noticed that one Fitzroy native used the word “narnun” which was otherwise only used by the McKenzie River man.

The boy from the Connobie district who was examined had been taken away from his own district when young and did not know the colour names of his tribe.

I cannot guarantee the accuracy of those vocabularies as I can those of the Torres Strait languages, but I think there can be no doubt as to the main features of the colour terminology of those tribes. In all cases there were definite words for black, white and red, the word for red being used also for purple, and in some cases for orange. The Fitzroy natives seemed to differ from those of Seven Rivers in that a fairly definite name for yellow and green had also been evolved. Blue and violet were by nearly all given the same name as black. There appeared to be no trace of a word for brown.

These main features appear to be generally characteristic of Australian languages. Kirchoff found that some natives of the Fraser River in Queensland only had definite names for white, black and red, the word for black being used for blue and dark colours in general. In addition to these definite colour names, Kirchoff obtained as

1. It was very difficult to distinguish between the k and g of the natives. Kirin was often much more like gur and guru like kara.

H. H.
many as 70 names, which were almost certainly of the same kind as those used in Mabang, and it is possible that with more complete investigation I should have found the same with my natives. In the Middie Burruw district in Queensland Semen' only gives names for black, white and coloured. Roth* states that the natives of North-West Central Queensland have definite names for red and yellow, and that blue is very often confused with black, so far as non-assimilative is concerned. It is perhaps worth noticing that in the comparative vocabulary given by Matthews in Engahawk and Creuir, only the words for red, white and black are included.

The Australian languages present a lower stage of evolution than was found in Torres Straits. In what one may regard as the lowest of the three Papuan languages, viz. that of Kiwai, there were certainly definite terms for red and yellow, while green was probably in process of being distinguished by a special term. The Palau language may have been so, as far as my evidence goes, to be one in which a term has come into use for yellow and green, these colours being still classed together, while in the Seven Rivers languages the definite colour vocabulary appears to be limited to three terms. This stage of the evolution of colour language has been found in other parts of the world. The Tudes of the Ngiiri Hills are said only to have words for white, black and red. Ribe's states that the people speaking the Akwam dialect of the Tahi language in West Africa only have three adjectives for single colours, viz. faa, white; tanning, black; and koko, red. They call blue "heh," obviously a corruption of the English word. According to Hagnard, the Batsi have only three words for colours, one for black, which also means blue, one for white, which also means yellow and light, and one for red; Melanesia states that the natives of New Caledonia only have definite terms for black, white and red.

GENERAL RESULTS.

The first general result of these investigations on colour vision is to show that the ordinary forms of colour-blindness in which red and green are confused does not occur or is extremely rare in Torres Straits. This opinion is based not only on the results of the tests with Roboguy's words, but on the observations made with the tintometer. In every case examined with this instrument there was a high degree of sensitiveness to red, and the partial insensitiveness to red, which seems not uncommon among Europeans (apart from definite colour-blindness), was not found in any of the tests used and also failed to show any indication of red-green blindness. These results contrast very strongly with those obtained from the few natives of the island of Lifari examined. The numbers were too small to allow any generalisation, but it is sufficiently striking that three out of eight Lifarians should be colour-blind while 150 natives of another race should be wholly free from this defect.

1 In the Anthropology Rock, p. 201. 1899.
2 Ethnographical Studies among the North-West Central Queensland Aborigines, p. 112. 1897.
4 Kiepert der Amshey-hikuhe der Omorth-parar, Basel, 1833.

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Footnotes:

1. In the Anthropology Rock, p. 201. 1899.
2. Ethnographical Studies among the North-West Central Queensland Aborigines, p. 112. 1897.
A considerable number of investigations have been made on different races, which all tend to show that colour-blindness is much rarer in many races than it is among Europeans.

Schellong1 notes that the colour sense of the natives of German New Guinea is excellent, but no definite observations have been previously made on Papuans. With the exception of the observations already mentioned on inhabitants of the Loyalty Islands, we have no definite evidence as regards colour-blindness among the Melanesians.

In the African division of the Negroes, some observations have been made. Among 57 Congolese, 44 male and 13 female, examined by Porgenson,2 none were colour-blind. Of about 56 Niuhans examined at different times and by different investigators in Germany, none were found to be colour-blind except the one man already mentioned (p. 51), who was said to be an example of yellow-blue blindness.

Küng3 examined three Zulus in Berlin, and these observations are interesting, in that the natives were examined with a special apparatus (Helmholtz's Lencoscope) and were found to have normal colour systems like those of Europeans.

Observations have also been made on the African negro in America. In the Sanitary Memoirs of the war of the American Rebellion,4 Gould gives the amount of colour-blindness among full blacks as 11 per cent, while among white soldiers it was 22 per cent, among sailors only 4 per cent, and among students only 3 per cent. His methods were, however, very unsatisfactory, and he included cases of confusion between green and blue among his colour-blind. Burnett5 examined 3040 Negro children by Holmgren's method, and found among 7349 boys 1.6 per cent, colour-blind, and among 1681 girls only 1.1 per cent.

Among Polynesians a large number of observations have been made on Hawaiians. Brightman6 quotes (from the Hawaiian Gazette of Nov. 16th, 1881), that among 294 males, five cases of colour-blindness had been found, viz. 1.5 per cent. There was no case among 103 females. Stephens7 examined 30 Hawaiian no. 65 boys and 96 girls without finding one case. Siggel8 found four Hawaiians who were tested in Munich to be normal.

A large number of Chinese and Japanese have been examined. Fields9 examined with Thomson's arrangement of Holmgren's white 600 Chinese men, finding 19 colour-blind (317 per cent) and 600 women, of whom only one was colour-blind. These observations appear to have been very carefully made. Stephens10, on the other hand, only found one case of colour-blindness in 1069 Chinese, though it tended to confuse green and blue. According to a note in the Japanese (1885, p. 76) 750 Japanese examined 1060 Chinese without finding one case of colour-blindness.

2 Jena., 1889, p. 420.
5 See Siggel, Other-Misfits, Berlin, 1907, p. 69.
6 Des Amelang, 1882, p. 337.
10 ib. cit.
Stephenson also gives numerous observations on the Japanese, partly by himself, partly by Prof. J. C. Berry, and partly from the official army reports. Among 2169 males from the different sources, 57 (2.6 per cent.) were either definitely colour-blind or had defective colour sense. Of 570 Japanese girls examined by Stephenson, one was colour-blind and three had weak colour sense (confused blue and purple).

Stephenson also examined 50 Koreans and 215 Amiames without finding one case of colour-blindness. In 45 male and 35 female Siamese, he found one boy colour-blind.

Among 476 male Malays, Stephenson found only one boy colour-blind. He also gives observations on 121 Eurasians (whose mothers were probably Malays) whose colour vision was normal.

In North America the only observations with which I am acquainted are those by Webster Fox on 250 young Amerinds of whom 161 were males. He found three cases of colour-blindness. Two were half-brothers, sons of a Cheyenne chief by different mothers, while the third belonged to the Sioux.

In South America, Rice examined 1500 males and 320 females, natives of Argentina. Among the males he found 3 per cent. of the boys and 21 per cent. of the men colour-blind. There was no case among the women. Koteleman examined three Eskimos in Germany. Their colour vision was normal.

I have been able to find very few references to examinations for colour-blindness in India. I have examined at Kandy and Colombo 21 Tamils and six Sinhalese (all males) whose colour vision was normal. Stephenson found two cases of colour-blindness among 55 Tamils. Koteleman examined 14 Sinhalese males, six Sinhalese females, and three Hindu men, none of whom were colour-blind.

More extensive observations have been made on the races inhabiting the sub-Arctic regions. Among 125 Edzinos examined by Alicequil, only one was found to be colour-blind, and of 19 Iñuit Eskimos examined by myself in London, none were colour-blind. 1

Among 31 Aleuts (30 females and one male) examined by Stephenson there was no case of colour-blindness.

Nine Lapps were examined by Koteleman, 15 by Seggel 11 and 20 by Alicequil, none of whom were colour-blind. On the other hand, Rabl-Birckhardt states that Swedish surgeons have found 6.32 per cent. of colour-blindness in 158 Lapp men and 2.9 per cent. in 111 Lapp women.

1 Loc. cit.
3 Quoted by Havelok Klitz, Man and Woman, p. 133.
5 Loc. cit.
7 Quoted by Havelok Klitz, Poesie Ethnographische (Reden undc), Bd. xxv. p. 229. 1896.
9 Loc. cit.
Kirchhoff found no colour-blindness in a group of Samoyeds, and Almeqvist found ten men of the same race normal.

Almeqvist examined 300 Chukchis very carefully by Holmgren's method and found nine completely colour-blind (i.e., red-green blindness). In 18 others there was either incomplete colour-blindness or the result was uncertain.

Of the races of Central Asia, Kotelnikow examined 19 Kaluaks (11 males and eight females), all of whom had normal colour vision.

Goltzschewsky examined 164 Nentses of the Caucasus, 14 of whom were colour-blind.

Before considering the foregoing results, it may perhaps be as well to sound a warning note about investigations for colour-blindness. Holmgren in recommending his method for collective investigations suggested that it should be simplified, and thought that 100 individuals might be tested in an hour. Investigators who have gone to work among uncivilized races with this advice in their minds will probably have obtained very unsatisfactory results, and the very large numbers examined in some cases suggest that the difficulties and possible fallacies may not have been recognized.

I am quite certain that the influence of language in testing cannot be wholly excluded, however much one may try to do so and that faulty results sometimes put together, not because an individual really regards them as closely similar to one another but because he gives the same name to both. This fallacy, however, will not account for the absence of colour-blindness which is the striking feature of the investigations cited. It will have been noted that among some nations as the Chinese, discordant results have been obtained. Many of the workers whom I have cited give no indication of their methods. In the case of China, Miss Field has given details of her method and results and there can be no doubt that, at any rate, some of her cases of colour-blindness were genuine. In the reports of MacGowan's and Stephen's work, on the other hand, we have merely a bare statement of the fact that they found no or few cases. No indication is given that they observed any of the interesting features which a really careful examination would almost certainly have brought to light. Of the other investigators cited, the most complete and satisfactory appears to have been that of Almeqvist on the Chukchis. It is perhaps noteworthy that both in this investigation and in that of Field the proportion of cases of colour-blindness in males was not widely different from that found among Europeans (viz., about 4 per cent). In many investigations which were no doubt satisfactory as regards method (such as those of Kotelnikow and Pergus) the numbers are hardly sufficient to allow one to draw any definite conclusions. It certainly seems, however, as if colour-blindness must be distinctly rarer in many races than it is among Caucasian and Semitic peoples.

1 See Aslund, 1892, p. 246.
3 Kotelnikow, J. Physiolog. 1894, p. 42. 1885.
5 Bishop, Contr. Ent. 1896, p. 304. 1891.
6 Contr. Ent. 1896, p. 304. 1891.
The striking contrast presented by the natives of Life with those of Torres Straits at once suggests that the existence of colour-blindness in a race might be of great importance as an ethnic character, and the other data also tend to show that colour-blindness may be a characteristic of certain races and the existence or absence of this defect may help us in the difficult task of deciding on ethnic affinities.

In spite of large advances in our knowledge of red-green colour-blindness, we are still almost wholly ignorant of the physiological conditions upon which it depends. In the case of the rare condition, total colour-blindness (in which all colours are confused with one another), we now have a good clue to its physiological nature1 but the common form of the defect is still shrouded in mystery. Some writers (Hayem2, Ladd Franklin3) have supposed that colour-blindness is an achromatic condition, and this view has been supported by the fact that the vision of the peripheral retina of the normal individual very closely resembles the vision of the colour-blind man. It has been supposed that at one stage of our development, the whole retina was red-green blind and that the power of seeing red and green has developed late and is still limited to the central region of the retina. The observations on the more primitive races of mankind give no support to this view. The evidence so far as it goes is rather in favour of the view that the sensibility for red developed earlier than that for other colours.

Although the ordinary form of colour-blindness was absent in Torres Straits, the colour vision of the Papuans and of certain other races examined was certainly not of the same type as that of Europeans. I may here shortly sum up the reasons which have led me to conclude that the colour vision of the Papuans is characterized by a certain degree of insensitivity to blue (and probably green) as compared with that of Europeans. To start with the defect of language; the races examined by me had either no word for blue or an indefinite one, while their nomenclature for red, and usually that for yellow, was extremely definite. The physiological argument is, however, not a very strong one, for the defect of language might depend on many factors of which, however, physiological insensitiveness may be one. One cannot, however, wholly ignore the fact that intelligent natives should regard it as perfectly natural to apply the same name to the brilliant blue of sky and sea which they give to the deepest blue. I cannot help, too, attaching importance to some of the instances of nomenclature met with in Melbuke. I have already described how many of the older natives of that island compared every colour to some natural object, apparently showing, as regards most colours, a high degree of appreciation of differences of hue and shade, and yet these natives would deliberately compare a brilliant and saturated blue to the colour of dirty water or to the darkness of a night in which nothing could be seen. Every detail of the behaviour of the natives in connection with the naming of colour was consistent with the idea that blue was to them a darker or duller colour than it is to us.

The behaviour with Holmgren's wool pointed in the same direction; blue and

COLOUR VISION.

green were constantly confused; violet was matched with neutral or faintly pinkish woods; a saturated blue was occasionally confused with dark, or dull colours; the touches, while showing that they could certainly see blue and distinguish it from other colours, were yet in most cases consistent with the view that there was a certain degree of insensitiveness to this colour.

The quantitative observations with the tinctometer give still more definite evidence. They show that the Murray Island natives distinguish red when very faint much more readily than blue, while, by the same method, to European vision there is little difference. Unfortunately one is only justified in using this test as a means of determining the relative degree of sensitiveness to red and blue, but the observations show either that the Murray Islander is relatively much more sensitive to red than the European, or much less sensitive to blue. Probably he is both more sensitive to red and less to blue, but the deficiency in the latter respect is probably much greater than the superiority in the former.

On the other hand, the fact that the native of Torres Straits recognizes a saturated blue readily in indirect vision, must be regarded as evidence in the opposite direction, and I have already mentioned the conclusion which this fact renders probable, if not probable, viz., that the defective sensibility to blue which I believe is characteristic Papuan vision may be a function purely of his pigmentation, may be due to the relatively greater absorption of blue (and green) rays by the pigment of the region of central vision.

The bearing of this on the controversy mentioned at the beginning of this paper is obvious. In ancient literature, as among modern barbarians and savage men, it is the colour blue for which nomenclature is especially defective, and in Torres Straits this characteristic defect of nomenclature has been found to be associated with an appreciable degree of insensitiveness to this colour. The colour vision of the Torres Straits islander gives some support to the views of Gladstone, Geiger and Magniac that the defective colour language of ancient literature may have been associated with a defective colour sense.

There can be very little doubt, however, that any physiological insensitiveness which may exist, can only be one of the factors determining the characteristic features of primitive colour nomenclature. The deficiency which I have found in Torres Straits is only partial, and even if one were to assume that other races would show the same peculiarity, this partial deficiency could not wholly account for the total absence of a word for blue which is a feature of so many languages. To the European eye there is a much closer resemblance between blue and black and between green and black than there is between red and black and yellow and black, and this psychological fact was the basis of the theory of colour put forward by Goethe. The fact that this difference exists alone goes far to explain the earlier discrimination of red and yellow in primitive language.

Another important factor has probably been the distribution of pigments. I have

1 I cannot here go into the whole question of the historical evolution of the colour sense in man. I have given a short account of the present state of the controversy in an article in the Popular Science Monthly, vol. xxxii. p. 44. 1891.
already mentioned that it is a characteristic of primitive races to have special names for every natural object. If the savage has a special name for every coloured object, he will not require names for the abstract idea of colour. It is possible that it is only when he begins to use pigments that he begins to require names for colours. There can be very little doubt that the earliest pigments used by man were red, probably as a substitute for the blood which has so prominent a place in all savage rites and ceremonies. The wide distribution of red and yellow pigments probably helped to give these colours their prominent place. In Torres Straits there were both red and yellow pigments, but no green pigment was known, and the nearest approach to a blue pigment was a bluish-grey clay, "kohogud," which gave the derivation for one of the words used for grey, and in many other parts of the world blue pigments appear to be quite unknown.

Previous writers have insisted on the importance of pigments in relation to colour nomenclature, but K. v. d. Steinos believes that the distinction of colours by names to be later than the use of pigments, on the ground that among the Bakairi of Central Brazil the names of colours (except red) do not belong to the original Carib language and have a form which bears the stamp of newness.

Another factor which may have contributed to the cessation of the indefinite nomenclature for blue and green is the absence of aesthetic interest in nature on which I have already commented (p. 64). The blue of the sky, the green of the sea, and the general green colour of vegetation do not appear to interest the savage. It is the individual objects which he can take in his hands and use in his daily life which interest him, and it is to the attributes of those that names are given.

1 See Grant Allen, The Colour Sense, 1873, p. 334.
2 Unter d. Naturforschern Central-Brasilien, Berlin, 1894, II. 422.
4. VISUAL SPATIAL PERCEPTION.

Various observations were made on the perception of spatial relations. The subject investigated included—binocular vision tested by means of Hering’s fall experiment; double images; binocular movements in newly-born children; estimation of the length of a distance by the eye; accuracy of division of lines into two, three or more equal parts; quantitative estimation of two geometrical optical illusions, viz., that produced by the erroneous estimation of vertical as compared with horizontal distances, and the illusion known by the name of its first describer, Muller-Lyer. In addition rough observations were made on other geometrical optical illusions, on the apparent size of the sun and moon at horizon and zenith, the blind spot, and on the appearance of relief due to difference of colour.

BINOCULAR VISION.

The most satisfactory method of determining the existence of binocular vision is to use Hering’s fall experiment. In this experiment the observer looks through a large tube at a fixation point placed on a thin vertical wire. Small objects such as balls are then made to fall through the field of view at different distances from the observer, who has to state whether the falling object is nearer or farther from himself than the fixation point. Those with binocular vision are able, when using both eyes, to estimate the relative distances of such objects even when quite close to the fixation point, while individuals without binocular vision are in the same position as normal individuals when only using one eye, and are unable to judge the relative distances of the falling objects even when much nearer or farther than the fixation point. The necessary apparatus was constructed of cardboard with the hole which was used as a fixation point at a distance of two feet from the eyes. Shot varying in size was used as the falling object.

In the first few observations I obtained indefinite results, but this was found to be due to the fact that we were using the English expressions “close up” and “for it.”
away." The former was equivocal and might mean "close to the fixation point" as well as "nearer than the fixation point." I then made use of the native expressions "maike" (near) and "maringe" (far) with perfectly satisfactory results.

Seventeen individuals, nearly all men, were examined and, with one exception, gave definite results. With both eyes open, they were able to say whether the falling shot was "maike" or "maringe" correctly every time or nearly every time; while, with only one eye open, they were as often wrong as right. The one exception was a man named Charlie Rose who suffered from a tumor of the right orbit. The visual acuity of the right eye was fairly good, viz. 5/ (E method) as compared with 2 for the left eye, but he always wore a shade over this eye. He answered "maike" and "maringe" alternately all through. This man never cared about making visual observations (though ready enough in other matters) and it was possible that he was not trying to be correct, and I should not therefore like to say that his failure was due to disease of one eye.

One or two features in the observations of the others may be mentioned. Wrong answers with both eyes open were only given when the falling shot was quite close to the fixation point, while answers were often wrong with one eye when the distance between the falling object and the fixation point was as much as one foot.

A few natives called the falling shot "maringe" when at the same distance as the fixation point, and "okakis" (equal distance) when it was really somewhat nearer. This only occurred in a few individuals, but with them it was constant, and no case was noted in which the falling shot at the same distance was called "maike" or in which it was called "okakis" when slightly further. It is perhaps worth noticing that this result is in accordance with the concavity of the horopter at the distance of two feet from the eyes. The falling objects were necessarily to one side of the fixation point, and the form of the horopter may very well have influenced the answers. The shot used in these observations were much smaller objects than those ordinarily used in Hering's fall experiment and this smallness would allow the concavity of the horopter to make its influence felt.

If one use balls of different sizes in Hering's fall experiment it is found that in monocular vision the answers are influenced by the size; large balls tend to be estimated as nearer and small balls as further. I observed no trace of the influence of this factor in Torres Straits, but the shot used only differed from each other slightly in size, and the difference may not have been sufficient to have any influence.

A fact is that the experiment succeeded readily with much smaller objects as the shot used, may be taken as evidence of good capacity of vision or sharpness of observation. Unfortunately the test was not tried in any of the cases of marked subnormal acuity.

Another point, closely related to the preceding, which was tested in a few individuals, was the power of observing double images. I was unable to ascertain whether double images had ever been observed spontaneously by any of the natives, but I satisfied myself that both men and children were able to observe them.

The method used was to make the native look at his finger while I held a pencil nearer or beyond the finger and asked how many pencils he saw, while I watched his eyes to see that his fixation did not wander from the finger. Except in cases in which steady fixation was not kept up, two pencils were seen. I then covered one eye and asked which of the pencils had disappeared. In all cases the pencil that was said to disappear corresponded to the covered eye. The disappearance of the homonymous image when the pencil was further than the finger, and of the heteronymous image when nearer, gave an objective means of determining the reality of the double vision, which one would otherwise have had to take on trust. It seemed as if the natives were capable of observing double images as readily as the average European.

The analogous experiment in the case of touch, known as Aristotle’s experiment, was also found to succeed readily with these people.

Perhaps the main interest of these observations is to show that the Torres Straits people were certainly quite as good observers as the average European. Both these observations and also those previously described on the colour vision of the peripheral retina (p. 75) show that the natives were able to keep up for some time the effort of attention necessary for the steady fixation of an object even while observing objects in some other part of the field of vision.

It is generally agreed that the newly-born child of European parents does not show coordinated eye movements, while definite movements of binocular fixation are absent for about the first ten days of life. Bayliss and Engelmann have, however, recorded definite binocular fixation with movements of convergence in one child within a few minutes after birth, but this was certainly an exceptional case. Several children were born while we were in Murray Island and I examined several as soon as possible after birth. In all except one case, the children were asleep or so sleepy that the point in question could not be investigated, but with one child I was more successful. This child was the younger of twins. I saw him three or four hours after birth, and then neither he nor his brother opened their eyes while I was present. When seen again about twelve hours after birth the younger was awake and showed good eye movements; in lateral movements the two eyes appeared to go well together. He was watched for a long time without any divergence of the eyes being seen. Occasionally movements of convergence were seen but I could not satisfy myself that he definitely followed the movements of an object moved away from and towards him. The elder child continued in the same sleepy state as when seen earlier.

An isolated observation of this kind is not, of course, of much importance but it is interesting that a condition which appears to be very exceptional in European children should have been observed in one of the few opportunities which occurred of watching newly-born Papuan babies.

1 Archib. f. ophth. 1914, Bl. v. 89, vii. 1913, viii. 19.
Estimation of length by the eye.

A few observations were made with a piece of apparatus which I have used for some years in work on the visual estimation of length. It consists of a flat, ebonite rod, 25 cm. long, 10 mm. broad and 2.5 mm. thick. Along this rod there slides a cursor carrying an ivory plate of the same breadth as the rod, so that any given length of the black rod may be marked off. The back of the rod is graduated, and the moveable slide (cursor) carries on its posterior surface another scale with a pointer, so that the length of the distance marked off can be determined. The observer is given one of a number of similar flat rods varying in length from 3 to 20 cm., and has to move the cursor with its ivory plate till a given length of the rod is marked off which appears by the eye to be equal to the given rod (the standard). The length marked off is read on the scale at the back, and the operation is repeated a given number of times.

Unfortunately I did not begin to make observations with the apparatus till late in our stay in Murray Island, and I only give the figures of four elderly men in Table V.

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Standard</th>
<th>$A$</th>
<th>$B$</th>
<th>m.v.</th>
<th>$C$</th>
<th>m.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harry [Makino]</td>
<td>over 60</td>
<td>40 mm.</td>
<td>746</td>
<td>886</td>
<td>348</td>
<td>696</td>
<td>392</td>
</tr>
<tr>
<td>Ulai</td>
<td></td>
<td>80</td>
<td>7975</td>
<td>815</td>
<td>58</td>
<td>780</td>
<td>68</td>
</tr>
<tr>
<td>Jimmy Dai</td>
<td>40-60</td>
<td>80</td>
<td>709</td>
<td>775</td>
<td>32</td>
<td>761</td>
<td>26</td>
</tr>
<tr>
<td>Capiche</td>
<td>40-45</td>
<td>80</td>
<td>7713</td>
<td>804</td>
<td>328</td>
<td>734</td>
<td>328</td>
</tr>
</tbody>
</table>

Two standards were used in each case, one 8 cm. and the other 16 cm. in length. Ten measurements were made with each standard; in the first five observations, the moveable slide was moved inwards so as to shorten a long distance till it appeared equal to the standard; in the second five observations, the cursor was moved outwards, lengthening a short distance till again equal to the standard.
In Table V the figures in column A give the averages for the whole ten observations; those in column B, the averages for the first five observations when moving the cursor inwards, and those in column C, the averages when moving the cursor outwards. The other columns give the mean variation of each set of observations.

The cases are very few in number, but one or two features are fairly constant. There was a distinct tendency to make the variable length shorter than the standard. Care was taken that both standard and variable should be seen at the same visual angle and the constant error was not due to the variable being nearer to the eye than the standard.

The starting-point of the cursor had a marked influence on the results. With one exception (Usk, with standard 16 cm.) the variable was made larger when a long distance had to be shortened than when a short distance had to be lengthened, and in some cases the difference was very great. English observers when making similar observations are influenced in a similar way, and the same peculiarity is also very marked in the observations on the “Müller-Lyer” Illusion to be described later (see p. 120).

The mean variations are very irregular; they are, on the whole, larger for the larger standard, but varying degrees in which the factors of practice and fatigue have come into play, prevent any regularity in the relation between the two.

**Bisection of Lines.**

A larger number of observations were made to show the degree of accuracy with which lines could be divided by the eye into two, three, or more equal parts. In all cases the lines used were 100 mm. in length.

In Murray’s observations on bisection of lines were made on 20 men and 12 boys, each of whom made a mark with a pencil at the point which appeared to him to be the middle of the line. Owing to the thickness of the pencil used, the chances were many cases not possible to measure the lengths of the two halves with any very great accuracy, and the results are not to be compared with those made by means of accurate apparatus. The difference between the two halves, however, usually amounted to more than a millimetre.

At first some observations were made with both eyes open, some with only the right eye open, and others with only the left eye open. It seemed, however, as if the extra trouble of keeping one eye shut or covered was sufficient to distract the attention from the main object, and as the observations made in a few cases did not show any obvious difference in the results for the two eyes, I discontinued the monocular method and all observations were made with both eyes open.

In dividing with both eyes, the average result for the 20 men was 54:4:45:6, i.e., the left half of the line was made too long; this occurred in 15 of the men, only four making the left half too short, while in one case the halves were equal.

Nine men had three or more trials and their results are given in Table VI, together with the mean variations of each set of three (or more) observations.
ANTHROPOLOGICAL EXPEDITION TO TORRES STRAITS.

Sambo was tested on two different occasions, and each time he made the left half much too long. It will be seen that the average result for the nine individuals included in the table does not differ appreciably from that of the whole 29. The extreme individual measurements were 57:43 and 46:54 made by Sambo and the Manus.

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>No. of measurements</th>
<th>Left half</th>
<th>Right half</th>
<th>m.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manus</td>
<td>over 60</td>
<td>3</td>
<td>467</td>
<td>513</td>
<td>543</td>
</tr>
<tr>
<td>Uai</td>
<td>55–60</td>
<td>3</td>
<td>510</td>
<td>490</td>
<td>50</td>
</tr>
<tr>
<td>Georgia</td>
<td>55–40</td>
<td>4</td>
<td>560</td>
<td>460</td>
<td>15</td>
</tr>
<tr>
<td>Kaio</td>
<td>35–40</td>
<td>3</td>
<td>520</td>
<td>480</td>
<td>66</td>
</tr>
<tr>
<td>Mobo</td>
<td>20–35</td>
<td>3</td>
<td>543</td>
<td>493</td>
<td>77</td>
</tr>
<tr>
<td>Samuel</td>
<td>20–25</td>
<td>5</td>
<td>550</td>
<td>450</td>
<td>12</td>
</tr>
<tr>
<td>Konaberri</td>
<td>20–25</td>
<td>3</td>
<td>530</td>
<td>490</td>
<td>90</td>
</tr>
<tr>
<td>Zebob</td>
<td>20–25</td>
<td>3</td>
<td>510</td>
<td>490</td>
<td>122</td>
</tr>
<tr>
<td>Tepen</td>
<td>18</td>
<td>3</td>
<td>467</td>
<td>513</td>
<td>43</td>
</tr>
<tr>
<td>Average</td>
<td>30</td>
<td>510</td>
<td>485</td>
<td>128</td>
<td></td>
</tr>
</tbody>
</table>

The average result for the 12 boys was 50:1:459. Six of the 12 made the left half too long; and six too short. The error which seemed to be fairly constant in the men was not present in the case of the boys. The extreme individual measurements were 56:44 and 42:58.

Six boys made six observations each. Their results and those of three boys who made three observations each are given in the following table.

The number of observations made was too few to allow any definite conclusions to be drawn, but there appeared to be a distinct tendency in the case of the men to make the left half too long, a tendency which was absent in the children. The average mean variation of the men was distinctly smaller than that of the children, showing that the
difference was not due to greater inexactness and insecurity of measurement in the former.

In dividing a line with the right hand, one is apt to cover with the hand part of the right half of the line. It is possible that in some cases the greater length of one half may have been due to this but in some cases in which one half was made much too long I have expressly noted that the line was not covered with the hand.

In Table VIII. are given the results of the Murray Island adults and children who made three observations, together with the results of fifteen English students of psychology and twelve school children from the village of Girton near Cambridge, also making three observations each. The latter ranged in age from 9 to 15, and were on the average slightly older than the Murray Island boys included in the table.

3 I am very much indebted to Dr Lawrence, Rector of Girton, for his kind assistance in making these and other observations on the Girton children.
The extreme individual measurements of the students were 52:48 and 46:34. Those of the children were 55:47 and 45:35. The left half was made too small by eight of the fifteen students and by nine of the twelve children, and only in the case of the youngest boy was the left made distinctly longer than the right half. The error which was fairly constant in the English children was in the opposite direction to that of the Papuan men.

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>L</th>
<th>R</th>
<th>Average m.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray Island men</td>
<td>9</td>
<td>41:46</td>
<td>48:94</td>
<td>46:71</td>
</tr>
<tr>
<td>Murray Island boys</td>
<td>9</td>
<td>50:01</td>
<td>49:98</td>
<td>49:99</td>
</tr>
<tr>
<td>Students</td>
<td>15</td>
<td>49:1</td>
<td>39:9</td>
<td>44:5</td>
</tr>
<tr>
<td>Girton children</td>
<td>12</td>
<td>48:9</td>
<td>34:7</td>
<td>41:7</td>
</tr>
</tbody>
</table>

It will be seen from this table that in the English students there is a slight tendency to make the left half of the line too small, and that this tendency was distinctly more marked in the English children. In the Murray Island children this tendency was absent, while in the Murray Island men the error was of an opposite nature, the left half being made too large. The number of observations was too small and the method too rough to justify one in attaching much importance to these constant errors, and speculating as to their explanation. It is best to be content with recording the fact that nearly all the Murray Island men had a constant error in one direction, while the English individuals had an error in the opposite direction.

It is of more interest to notice the degree of accuracy and constancy with which the process of bisection was performed as shown by the mean variations. As might be expected, the average variation was much the smallest in the case of the students. There was, however, comparatively little difference between the average mean variations of the Girton children and those of the Murray Islanders. The Girton children were better than the Murray children, but the average for the latter was much raised by the very bad performances of one boy (Hokaka I), and further, the Murray Island children were hardly representative, most of the older and more intelligent boys not having made these observations. I have not yet been able to make observations on uneducated English adults for results which should be in some measure comparable with those of the Murray Island adults. The results given here show that the Murray Island man and boy are able to perform the simple operation of dividing a line into two equal halves with nearly as much accuracy and constancy as the English village child.

1 It will be seen in Table VII that this boy improved very greatly in his second set of observations.
I have already mentioned that a certain number of observations were made on the accuracy of halving a line when only one eye was used. It has been found by Kerck and others that the error half is made too long, i.e. there is underestimation of the half whose image falls on the nasal side of the retina. The insincerity of division to Murray Island was very much increased when only one eye was used, but the error was in the same direction as in the case of binocular division. With the right eye the left half was made on the average 53° to 60° for the right half and with the left eye the figures were 52°46 to 47°34. The errors were in the same direction in the case of each eye. One man, Theo, made the left half as much as 69 mm. Only one individual, Max, a very intelligent young man, made the left half too short, viz. 40 mm. These results only seem to show that the distortion occasioned by crossing or closing one eye made the operation more difficult and increased the tendency to make the left half too large.

The lines were also divided monocularly by a few children, their errors being much the same as in binocular division.

These monocular observations do not bring out any definite results in themselves, but they led to the observation of those which are not without interest. If one asks a number of Europeans to close each eye independently, one finds that many individuals cannot do so, or do so very imperfectly. The defect is usually greater in the case of one eye than the other, many individuals being unable to close the right eye while keeping the left open. The same variations were found among the Murray Islanders. Some could close and open each eye independently without any difficulty; others could close one eye more readily than the other as shown by the accompanying facial movements, while others were not able to close one or the other eye, difficulty being more often experienced in closing the right than the left eye independently of the other. One man could close neither eye independently.

It is interesting that so regards this simple accomplishment, one finds the same variations among Europeans. These people belong to a race who was the bow and arrow (now only used as an occasional game), but unfortunately I did not discover whether it was necessary to close one eye while taking aim.

**DIVISION OF LINES INTO THREE AND MORE EQUAL PARTS.**

A certain number of observations were also made to test the degree of accuracy with which lines could be divided into three or more equal parts. After having halved a line a native would be asked to divide a line into three parts equal to one another; most were unable to do this directly and made several unsuccessful attempts, chiefly owing to the fact that it was difficult for them to grasp the facts that in order to divide a line into three parts, it is only necessary to make two marks. Some, however, understood at once and divided the line with tolerable accuracy.

After having succeeded in dividing the line into three parts, they were told to divide it into four equal parts; most seemed to have learnt what was necessary and

did this at the first attempt. The chief exception was the oldest man, who only succeeded when I suggested to him that he should first halve the line and then divide each half. It is noteworthy that no one spontaneously adopted this method of dividing the line into four equal parts, all beginning from one end or the other.

Most of those who had succeeded so far were readily able to divide the line into five equal parts, but at six parts some failed, and only three men were able to divide the line into seven and eight equal parts. Both in the case of six and eight parts, no one began by bisecting the line.

The fact that the natives had to divide a line successively into three, four, five and more parts made the problem very much easier than it would have been had they been asked directly to divide a line into a given number of parts. Unfortunately I did not ask anyone to divide a line into four or more parts who had not previously divided it into two or three parts, but I have little doubt that in such a case the attempt would have resulted in complete failure.

In Table IX, the accuracy of division is shown by the mean variation of the individual parts into which the line was divided. Thus in dividing a line of 100 mm. into three parts, Usai’s figures were 36, 29, and 35 mm., varying from 32.98 by 2.67,

<table>
<thead>
<tr>
<th>Name</th>
<th>age</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usai......</td>
<td>55–60</td>
<td>128 (3)</td>
<td>20 (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gregy.....</td>
<td>35–40</td>
<td>206 (7)</td>
<td>10 (3)</td>
<td>24 (5)</td>
<td>24 (1)</td>
<td>127 (1)</td>
<td>129 (3)</td>
</tr>
<tr>
<td>Kajiya.....</td>
<td>30–40</td>
<td>171 (1)</td>
<td>20 (3)</td>
<td>40 (1)</td>
<td>failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mabo......</td>
<td>30–35</td>
<td>24 (1)</td>
<td>20 (1)</td>
<td>24 (1)</td>
<td>13 (1)</td>
<td></td>
<td>failed</td>
</tr>
<tr>
<td>Samba.....</td>
<td>30–35</td>
<td>120 (3)</td>
<td>20 (1)</td>
<td>44 (1)</td>
<td>failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Otie.......</td>
<td>25–30</td>
<td>273 (1)</td>
<td>20 (1)</td>
<td>28 (1)</td>
<td>174 (3)</td>
<td>206 (2)</td>
<td>15 (1)</td>
</tr>
<tr>
<td>Komabert...</td>
<td>20–25</td>
<td>153 (3)</td>
<td>20 (1)</td>
<td>24 (3)</td>
<td>454 (1)</td>
<td>423 (1)</td>
<td>15 (1)</td>
</tr>
<tr>
<td>Topen......</td>
<td>18</td>
<td>253 (4)</td>
<td>20 (1)</td>
<td>24 (3)</td>
<td>87 (1)</td>
<td>failed</td>
<td></td>
</tr>
<tr>
<td>Average...</td>
<td></td>
<td>240</td>
<td>230</td>
<td>200</td>
<td>217</td>
<td>202</td>
<td>188</td>
</tr>
</tbody>
</table>

1 Omitting Usai who only succeeded when he was told to first divide the whole line.
4\textsuperscript{3}3, and 1\textsuperscript{6}7 respectively and giving a mean variation of 2\textsuperscript{3}89. In the third column of the Table are given the mean variations in dividing the line into three equal parts; in the fourth column, those for four equal parts and so on. The figures in brackets give the number of trials in each measurement.

In Table X are given the mean variations of six Murray Island boys arranged in the same way as in Table IX.

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ehui</td>
<td>13</td>
<td>4 (3)</td>
<td>2.5 (1)</td>
<td>4.8 (1)</td>
<td>1.97 (1)</td>
<td>failed</td>
</tr>
<tr>
<td>Bzik</td>
<td>11</td>
<td>2.92 (2)</td>
<td>0.5 (3)</td>
<td>20 (1)</td>
<td>failed</td>
<td></td>
</tr>
<tr>
<td>Nansi</td>
<td>10</td>
<td>1.72 (2)</td>
<td>0.5 (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dalu</td>
<td>10</td>
<td>2.2 (1)</td>
<td>2.5 (1)</td>
<td>20 (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jimmy Dwirey</td>
<td>10</td>
<td>0.29 (2)</td>
<td>0.5 (1)</td>
<td>1.2 (1)</td>
<td>failed</td>
<td></td>
</tr>
<tr>
<td>Dagura</td>
<td>10</td>
<td>2.2 (3)</td>
<td>4.0 (1)</td>
<td>20 (1)</td>
<td>failed</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>8.4</td>
<td>2.4</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average, 12 Girton children</td>
<td>2.99</td>
<td>2.05</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It will be noted that all the boys with one exception required more than one trial before they succeeded in dividing into three parts. Not much importance can be attached to the averages under the circumstances, but it may be noted that those for the children are consistently smaller than for the adults, i.e. the accuracy of division was greater in the children.

At the end of Table X I have added the average variations for twelve Girton village children, and it will be seen that these are slightly smaller than those of the Murray children. One is not justified in comparing the two directly, but so far as they go, they tend to show that as soon as the Papuan understood what he was to do, he was not very inferior to the English child. There is one point in which, to my surprise, the English children resembled the islanders. With one exception (the eldest girl), none divided a line into four parts by dividing first into halves and then subdividing these. Even the girl who did this in the case of quadrisection, did not do so when dividing into six equal parts but began at one end.

14—2
There were a few other points of interest. All the English children with one exception (the youngest girl) divided the lines from left to right, i.e., in the same direction as in reading. Of the eight Murray men, four went from left to right, three began at the right-hand end, while one did some lines in one direction and some in the other. All the six Murray island children, on the other hand, began at the left-hand end and divided in the same direction as that customary in reading, and there can be little doubt that this was due to the influence of their school education.

Another feature which occurs in most cases is that the first division is made too small. This is more marked in division into four and five than into three parts, and is an obvious consequence of the procedure. After having divided into three parts, the observer knows that he has to make the divisions in the next case smaller, and there is a natural tendency to overdo this. The same tendency to make the first division too small was very marked in the Giton children.

Taking into account both the number of trials necessary before the lines could be divided successfully and the degree of accuracy as compared with the Giton children, we may conclude that the Torres Straits natives are distinctly deficient in this operation. When, however, one remembers the difficulty in language, and in understanding what was to be done, and normally their deficiencies in numeration, the results were surprisingly good. It has already been mentioned that in their own language these people only have definite words for one and two, and are now accustomed to use English numerals, and their powers of counting are still very defective (see p. 33).

ESTIMATION OF VERTICAL AND HORIZONTAL LINES.

The conspicuous estimation of vertical as compared with horizontal lines was tested by giving a native a horizontal line 100 mm. in length and asking him to draw a vertical line from its central point and to make the vertical line of the same length as the horizontal line. He was then given another horizontal line and was asked to draw a similar vertical line at one end of the horizontal line. Finally he had to draw a vertical line through the middle of the horizontal line so as to make a cross of which the vertical should be equal in length to the horizontal line. These three forms of the illusion will be spoken of as No. 1, No. 2, and No. 3.

Most of the natives understood the procedure readily. Several attempted to measure roughly with their fingers and a sharp look-out had to be kept that this was not done. After they had drawn the lines I endeavoured to ascertain whether they were satisfied that the lines were equal (āokai). If I had asked whether they had made the line too short or too long, I should obviously have run the danger of suggesting that the lines were not equal and I was therefore always careful to ask if the line was "tąpaui, piripiri, or ōakai" (short, long, or equal). If a native thought he had made the line "tąpaui," he was allowed to lengthen it; if "piripiri," I covered the upper part of the vertical till it appeared to him to be "ōakai" and the new upper end was then marked. The vertical in No. 2 was usually made longer than in No. 1, and after doing No. 2, several of the natives returned to No. 1 spontaneously and
lengthened the line. I allowed them to do this but marked off the original length of the line and have used that in the tabulation of my results. As a test that the people had understood and had grasped the idea of making the two lines equal, I often allowed them to measure, usually with a piece of grass, after they had finished and they did this quite correctly. In many cases the vertical, especially of No. 3, was made so short that I suspected that they were making it equal to half the horizontal instead of the whole, and the way in which they measured allowed one to see whether this was the case or not. Several of the natives were very surprised and interested in their errors and several proceeded spontaneously to lengthen their lines, thus Devi Tai had first made No. 2 only 55 mm., after measuring he lengthened it to 92, but then thought that he had made it too long. He also lengthened the vertical in No. 1 from 50 to 77 and from 58 to 85. Of the others who made the vertical in No. 1 very small, Metti seemed to understand. He first made No. 1 only 50 mm. and then caught him measuring with his fingers after which he lengthened the line to 65 mm.; nevertheless, on doing the test a second time, he again made the vertical only 30 mm. in length. Wag first made No. 1 55 mm., and then lengthened it slightly after having done No. 2. Tabi who made No. 1 55 and 58 in two trials seemed to understand perfectly. Gi, on the other hand, was doubtful; he was always very slow and had a good deal of difficulty in understanding what was to be done, but he remained quite contented with his line of 49 mm., even after having been shown the lines which other natives had drawn. Devi who made his line in No. 1 only 50 mm. in length, measured perfectly correctly afterwards, and Jimmy Rice in his first trial made No. 1 72 mm. in length but he was certain that he had made it "too high" and shortened it to 62 mm. The very low figures were not due to misunderstanding but were made by natives in whom either the illusion was very marked or who were careless in making the two lines exactly equal.

The results of twenty Murray Island men are given in Table XI. The figures give in millimetres the lengths of the vertical lines which appeared to the men to be equal to a horizontal line 100 mm. in length.

In the case of those men marked with an asterisk the test was performed twice, and the figures are averages of two observations. In the case of one man, Sanho, the figures are the averages of three observations. It will be seen that there was no difference between the average and the median. As some men made two or more sets of observations and others only one, I have also given the average obtained by taking only the first observations of the former. It differs hardly at all from the other average which shows that there was no special tendency for the illusion to change when more than one observation was made. The figures for M.Y. give the mean of the deviations of the individuals from the average. It is distinctly larger in the case of the first observations only. This is of course perfectly natural, for when an individual makes two or more observations the average of these will in most cases be nearer the general average than will the individual observations.

1 I may here recall the fact that m.v. in Tables V—VIII is used as a guide to the accuracy of an individual, while m. in this and following tables is used as a guide to the variability of the individuals making a given measurement (see Introduction, p. 6).
### TABLE XI.

**Horizontal line, 100 mm.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manus</td>
<td>over 69</td>
<td>66</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>Ulk</td>
<td>35—40</td>
<td>62</td>
<td>39</td>
<td>113</td>
</tr>
<tr>
<td>Gl.</td>
<td>43—46</td>
<td>49</td>
<td>81</td>
<td>73</td>
</tr>
<tr>
<td>Kung*</td>
<td>35—40</td>
<td>60</td>
<td>75</td>
<td>97</td>
</tr>
<tr>
<td>Greggy</td>
<td>33—40</td>
<td>88</td>
<td>89</td>
<td>86</td>
</tr>
<tr>
<td>Jimmy Rice*</td>
<td>30—35</td>
<td>61-5</td>
<td>65-5</td>
<td>82-5</td>
</tr>
<tr>
<td>Zamba*</td>
<td>30—35</td>
<td>66-3</td>
<td>72-3</td>
<td>78</td>
</tr>
<tr>
<td>Male</td>
<td>30—35</td>
<td>89</td>
<td>81</td>
<td>75</td>
</tr>
<tr>
<td>Dick (Tu)*</td>
<td>30—35</td>
<td>64</td>
<td>42-5</td>
<td>8-5</td>
</tr>
<tr>
<td>Wang</td>
<td>35—30</td>
<td>65</td>
<td>93</td>
<td>109</td>
</tr>
<tr>
<td>Dali</td>
<td>35—30</td>
<td>50</td>
<td>65</td>
<td>94</td>
</tr>
<tr>
<td>Matti*</td>
<td>35—30</td>
<td>52</td>
<td>78</td>
<td>81</td>
</tr>
<tr>
<td>Ginea</td>
<td>25—30</td>
<td>55</td>
<td>70</td>
<td>99</td>
</tr>
<tr>
<td>Komaberi</td>
<td>30—35</td>
<td>87</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>Zanbi</td>
<td>30—35</td>
<td>81</td>
<td>82</td>
<td>89</td>
</tr>
<tr>
<td>Tali*</td>
<td>20—25</td>
<td>90-5</td>
<td>71</td>
<td>95-5</td>
</tr>
<tr>
<td>Tapas*</td>
<td>20—25</td>
<td>84-5</td>
<td>78</td>
<td>99-5</td>
</tr>
<tr>
<td>Tepem</td>
<td>18</td>
<td>69</td>
<td>86</td>
<td>93</td>
</tr>
<tr>
<td>Mades</td>
<td>35</td>
<td>71</td>
<td>84</td>
<td>80</td>
</tr>
<tr>
<td>Beul*</td>
<td>17</td>
<td>21</td>
<td>85</td>
<td>97-5</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>67-2</td>
<td>77-6</td>
<td>91-4</td>
</tr>
<tr>
<td>Medians</td>
<td></td>
<td>80-2</td>
<td>78-0</td>
<td>92-0</td>
</tr>
<tr>
<td>M.V.</td>
<td></td>
<td>9-29</td>
<td>7-36</td>
<td>8-78</td>
</tr>
<tr>
<td>Average, 1st observations only</td>
<td></td>
<td>66-7</td>
<td>77-0</td>
<td>90-1</td>
</tr>
<tr>
<td>M.V., 1st observations only</td>
<td></td>
<td>10-13</td>
<td>7-65</td>
<td>9-75</td>
</tr>
</tbody>
</table>
### Table XII

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee*</td>
<td>13</td>
<td>60</td>
<td>69.5</td>
<td>57</td>
</tr>
<tr>
<td>Dick*</td>
<td>13</td>
<td>78</td>
<td>82.5</td>
<td>93.5</td>
</tr>
<tr>
<td>Jimmy Roe*</td>
<td>12</td>
<td>67</td>
<td>94</td>
<td>90.5</td>
</tr>
<tr>
<td>Captain*</td>
<td>11</td>
<td>84.5</td>
<td>96</td>
<td>109.5</td>
</tr>
<tr>
<td>Charlie (Alex)</td>
<td>11</td>
<td>92</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>Tom (Turn)</td>
<td>11</td>
<td>79</td>
<td>78</td>
<td>93</td>
</tr>
<tr>
<td>George (Paul)</td>
<td>11</td>
<td>89</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>Bobak*</td>
<td>11</td>
<td>81</td>
<td>87.5</td>
<td>113</td>
</tr>
<tr>
<td>Nomi*</td>
<td>19</td>
<td>86.5</td>
<td>84.5</td>
<td>88</td>
</tr>
<tr>
<td>Dali*</td>
<td>10</td>
<td>73</td>
<td>76.5</td>
<td>82</td>
</tr>
<tr>
<td>Jimmy Dama*</td>
<td>16</td>
<td>99.5</td>
<td>79.5</td>
<td>104.5</td>
</tr>
<tr>
<td>Depoma*</td>
<td>10</td>
<td>78</td>
<td>78</td>
<td>87.5</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>79.5</td>
<td>83.7</td>
<td>97.5</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>89</td>
<td>84</td>
<td>96</td>
</tr>
<tr>
<td>M.V.</td>
<td></td>
<td>73.7</td>
<td>69.2</td>
<td>120.5</td>
</tr>
<tr>
<td>Average, 1st observations</td>
<td></td>
<td>78.7</td>
<td>84</td>
<td>100</td>
</tr>
<tr>
<td>M.V.</td>
<td></td>
<td>7.07</td>
<td>7.08</td>
<td>12.84</td>
</tr>
</tbody>
</table>
The average length of the vertical line in No. 1 was distinctly smaller than in No. 2, and in No. 2 than in No. 3. There is a great conciseness in this respect; only one man (Mabo) made the vertical in No. 1 longer than in No. 2, and only three men made No. 3 shorter than No. 2.

It was in No. 1 form of the test that the very small verticals were drawn on which I have already commented. The figures given in the foregoing table support the view that these observations were genuine and not due to misunderstanding, for the table shows regular gradations between these low figures and the maximum (88). There is no break in the series as there should be if the lowest results were due to the fact that the vertical was made equal to only half the horizontal line. It may be noticed that only four of the 29 men made the vertical longer than 75 mm., i.e. 16 out of 29 men the illusion exceeded 25 per cent.

In Table XII are given the figures for 12 Murray Island boys. The figures for the majority (marked with asterisks) are the means of two observations, and as in Table XI, give the height of the vertical line in millimetres.

As in the case of the men, there was very little difference between the average and the median. The difference is most marked in the case of No. 3, which is quite natural when one looks over the figures and observes such measurements as those of Ebei, Captain and Binkin. The averages for the first observations do not differ greatly from those of the other averages, the difference again being most marked in the case of No. 3 form of the test.

The boys made the vertical line longer than did the men in all forms of the test, i.e. the illusion was apparently less marked. The figures for the three forms stood in the same relation to one another as in the case of the men, but the difference was much less marked and the individual observations were not quite so consistent, three boys making No. 1 longer than No. 2, although only one made No. 3 shorter than No. 2. The mean variation of the individuals from the average was less than that of the men, in the case of No. 1, but very much greater in the case of No. 3.

Only two men did this test in Mabunug. Of these, Waria was one of the most intelligent men in Torres Straits, and he did the tests more correctly than anyone else. His figures for two observations were 96 mm. in each case for No. 1; 99 mm. and 97 mm. for No. 2, and 94 mm. and 98 mm. for No. 3. The other man, Gigh, was not very bright; his figures were 89, 89 and 107-2 mm. respectively. The word used for short in Mabunug was “taupaun,” for long “kukitalang,” for equal “matemanu;” and for middle “matanahil.”

When at Bulas in central British New Guinea, Mr Seligmann tried the test on seven young men ranging in age from 16 to 25. The results were similar to those in Torres Straits. In the first form of the test the average was 61-4 mm., with a maximum of 77 and a minimum of 50 mm. In the 2nd form the average was 50-5 with a maximum of 129 and a minimum of 71. The average in this case was very much pulled up by the maximum observations.

In the third form of the test no less than four made the vertical too long, and one as much as 147, the result being an average of 105 mm.; the minimum was 73. The results, though curious, show the same general behaviour in doing the test as in Torres Straits.
A Fly River man was also tested in Murray Island. His observations were (i) 65, (ii) 74, (iii) 87.

One Samoan boy, age 14, was tested in Murray Island. His averages of two observations were (i) 76, (ii) 90.5, (iii) 110.5.

I have made observations on a number of English people by exactly the same method. In the following comparative table I have given the results for the same 13 students of psychology and 12 children of Girton village who made observations on one division. I have been unable at present to make similar observations on uneducated English adults. In both the students and the children there was no appreciable difference between the average and the median result and therefore I have not given the latter.

The maximum and minimum measurements made by any individual in each group, and for each form of the test, are also given.

**Table XIII.**

<table>
<thead>
<tr>
<th></th>
<th>No. 1</th>
<th></th>
<th>No. 2</th>
<th></th>
<th>No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Average</td>
<td>Max./Min.</td>
<td>M.V.</td>
<td>Average</td>
</tr>
<tr>
<td>Murray Island men</td>
<td>12</td>
<td>65-7</td>
<td>88/40</td>
<td>10/4</td>
<td>77.0</td>
</tr>
<tr>
<td>Murray Island boys</td>
<td>12</td>
<td>72/5</td>
<td>91/56</td>
<td>7/6</td>
<td>84.3</td>
</tr>
<tr>
<td>English students</td>
<td></td>
<td>89.0</td>
<td>101/72</td>
<td>8/72</td>
<td>90.0</td>
</tr>
<tr>
<td>Girton children</td>
<td></td>
<td>78/2</td>
<td>96/82</td>
<td>8/53</td>
<td>88.7</td>
</tr>
</tbody>
</table>

On comparing the four groups in Table XIII, it will be seen that the illusion was most marked in the case of the Murray Island men. They differ from the other groups especially in the first form of the test. The mean variation of the individuals from the average is large, viz. 10/12, but I have already given reasons for believing that the results were genuine and not due to misunderstanding.

There was little difference between the Murray Island and the Girton children, especially in the first two forms of the test. The results of the Murray Island boys in the third form of the test were not very satisfactory as the large mean variation shows. The largeness of both the average and of the variation was, however, chiefly due to the presence of four boys who made the vertical too long. The illusion was last pronounced in the case of the students of psychology. This must be partly ascribed to the fact that they were acquainted with the illusion, and in more than one case had been trained to overcome it.

R. H. 15
I am not acquainted with any previous investigation of this illusion on a number of individuals, but numerous investigations have been carried out by individual workers. Chodz1 found that the illusion varied with the length of the standard line and was most marked for a distance of 80 mm., in which case the illusion amounted to 95 per cent. Wundt states that the illusion is more marked in distances between points than with lines; and says in the former case amount to 90 per cent. This was approximately the extent of the illusion for the No. 1 form in both Murray Island and Girton children, while in three of the English students the illusion reached or exceeded this extent in this form of the test.

The most interesting fact, however, brought out in the comparative table is that all groups, Papuan and English, adults and children, agree in making the vertical line shorter when drawn from the middle of the horizontal line than when drawn at one end, and shorter in the latter form of the test than when it is drawn as a form of cross. The difference is most marked in the case of the Murray Island men and least marked in the English students, while the black and white children occupy an intermediate place as they do in respect of the absolute amount of the illusion. So far as I am aware, this difference has not previously been observed.

The magnitude of the illusion in the No. 1 form is probably due to the fact that there is a tendency to compare the vertical line, not with the horizontal line as a whole, but with each of the halves into which the latter is divided.

Several English individuals who have done this test, and have made the vertical line very little shorter than the horizontal, have told me that they imagined the vertical line divided into two halves, and compared each of the halves with the halves of the horizontal line, and by this means were able to greatly lessen the illusion.1

This observation illustrates very well one cause of difference between the results of the savage and the cultured measurements, for one may feel fairly confident that such an artificial method was not employed by the Murray Islanders.

The second form of the test seems to be the simplest and gave the most uniform results. Except in the case of the Murray Island boys, the mean variation of the individual observers was much smaller than in the first form of the test. The second form of the test is probably most nearly a measure of the erroneous estimation of vertical as compared with horizontal lines uncomplicated by other factors.

The third form of the test gave results which I had not at all expected. In all the groups, the vertical line approached the horizontal line much more nearly in length. In many cases (five of the Murray Island men, five of the Murray Island boys, four of the English students and one of the English children) the vertical limb of the cross was made longer than the horizontal. Some of the Murray Island individuals who did this were certainly careless and not among the best observers, but I do not think there was any doubt that they understood perfectly well what they were doing.

2 The illusion would be lessened because the individual would get rid of the tendency to compare the whole vertical line with half the horizontal line and also, as Chodz has shown, the illusion is less marked for a line of 90 mm. than it is for one of 40 mm.
and did not see any very striking difference between the two lines. It is noteworthy that this failure occurred in all four groups and also in the New Guinea natives examined by Mr. Schlegelmilch but I cannot suggest any satisfactory explanation.

It is, however, readily intelligible that the illusion should be less marked in the cross than in the other forms of the test. It is natural to compare the halves of one line with the halves of the other line and, as already mentioned, the illusion is less for lines of 50 mm. than for lines of 100 mm.

In the second place, I think it is possible that, even in the case of the Murray Islander and the child, the cross may give an idea of a figure in which any difference in the relative lengths of the diagonals would produce an effect which would not be noticed in the lines themselves.

It occurred to me as possible that vertical distances below the horizontal might not be wrongly estimated in the same way, or to the same degree, as vertical distances above the horizontal, but in my own case there is no difference, and I have since found that Chodorow investigated this point and his figures show that there is no obvious difference in the erroneous estimation in the two positions. Further, on the other hand, found that the illusion was slightly greater in the case of the lower vertical arm of the cross than in that of the upper, the figures in the two cases being 14.97 per cent. and 11.60 per cent.

In comparing the individual results for the Papuans and the English students, there is one point of some interest. The average results of the latter showed the characteristic difference in the three forms of the illusion, but the English individuals were not so consistent in this respect as the Papuans. Seventeen out of the twenty Murray Island men made the vertical in No. 1 shorter than in No. 2, and in No. 2 shorter than in No. 3, but only eight of the fifteen students showed this feature. This is only one example of a point to which I have called attention in the Introduction, viz., that in some respects the results for students of psychology are less consistent than those of the Torres Strait Islanders, and I am inclined to attribute this result to the influence of a factor, viz., knowledge of the nature of the illusion, which is not present in the savage. The fact that some people make use of artificial aids, as in the observations I have cited, introduces another complicating factor in the case of the Europeans.

I have used the same test on all the members (112 in number) of an elementary boys' school. Each boy made the three measurements once only. The observations differ from those already described in that each boy was not watched individually while drawing his figures. The average lengths of the vertical lines in the three forms were 387 mm., 940 mm. and 990 mm., respectively. The three forms of the test showed the characteristic difference, and as in the other groups a large number made the vertical in No. 3 longer than the horizontal. In all three forms, the vertical lines were made considerably longer than in the case of the children, but this may be, at any rate partially, explained by the fact that, owing to absence of individual supervision, the boys were not given the chance of shortening their lines if they thought they had made them too long. In fact, my method was defective and I only mention these
results because they show the characteristic relation between the three forms of the test.

Psychologists are very divided in their opinions as to the cause of the erroneous estimation of vertical as compared with horizontal distances. The apparent difference in the lengths of two equal lines has been referred to the influence of the curvature of the retina; it has been supposed that the retina is more concave in one meridian than in the other, so that the extremities of equal lines stimulate retinal points at different distances from one another in the two meridians. If any such difference in the curvature of the retina exists, it is certainly far too slight to account for the great difference between horizontal and vertical lines which appear equal to one another.

Perhaps the most popular explanation is that which refers the illusion to the influence of eye movements. It is supposed that vertical movements of the eye require a greater muscular strain than those in the horizontal direction, and that the sensations arising from the greater muscular strain form the basis of the idea of greater length. The influence of sensations arising from movements of the eyes in spatial perception has been greatly overrated, but in this case I think there is little doubt that, in looking at a figure representing the illusion, one seems to take in the horizontal distance at a glance while one's idea of the vertical distance is gained more slowly, and this difference may be one of the factors producing the illusion. It cannot, however, wholly explain the illusion, for this is present when a figure is instantaneously exposed.

A factor, which is probably of some influence, is the size of the field of vision. Even in monocular vision the field is not circular but oval, the shortest diameter being vertical. In binocular vision, the oval shape of the field of vision (or field of sight) is still more pronounced and it seems quite possible that a vertical distance may be overestimated as compared with an equal horizontal distance because it forms a larger proportion of the field of vision.

By many the illusion is given a purely psychological explanation. This and other illusions are referred to certain psychological tendencies which influence the process of perception. Thus, Lippé supposes that we ascribe certain mechanical activities to geometrical figures and believe that we ascribe activity more readily to vertical than to horizontal lines.

So far as I am aware, it is not generally recognized by psychologists that the illusion in question and other similar illusions are extremely pronounced in children. My attention was first called to this point by Mr. W. H. Winch, and I have since found that teachers are well acquainted with the fact. The pronounced character of the illusion in children and in people in the stage of mental culture of the Murray Islanders shows that the illusion is primitive and deeply seated, and that its source is to be

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1 It would of course be equally correct to say "erroneous estimation of horizontal as compared with vertical distances."


sought in some physiological condition, or if it is at present necessary to be content with a psychological explanation, this must be of a simple and primitive character.

THE MÜLLER-LYER ILLUSION.

Another visual illusion which I investigated quantitatively, was that first described by Müller-Lyer\(^7\), which has since been the subject of much controversy.

In Fig. 2 the distance \( BD \) appears much longer than the distance \( AB \) owing to the influence of the adjoining oblique lines.

\[ \text{Fig. 2.} \]

In investigating this illusion, I adopted the method first employed by Heymans\(^6\); the figure was drawn on a surface consisting of two parts, of which one fitted into a groove above the other like the lid of a box so that the upper could slide over the lower part.

The distance \( AB \) was constant and the distance \( BC \) was variable.

The line from \( A \) to a point \( D \) was drawn on the sliding portion while the rest of the figure was drawn on the underlying surface so that the line \( BC \) could be made of any desired length by sliding the cover backwards and forwards. The instrument was constructed of lines with the figure painted in black on a white background.

The constant length of \( AB \) was 75 mm.; the oblique lines were each 20 mm. in length and were at an angle of 30° to the chief line. The thickness of the lines throughout was 2 mm. This thickness is greater than is desirable, especially owing to the fact that the lines tend to encroach on the distance \( AB \) and thereby increase the illusion. The instrument was constructed for me under great pressure of time and was not exactly accurate, and the results obtained in using it may not be directly comparable with those obtained by others, especially if thinner lines are used. The observations on both Papuans and Europeans described in this communication were, however, made with the same model and are strictly comparable.

The problem given to a native was to slide the moveable part \( AD \) till \( BC \) appeared to him to be equal to \( AB \); the result of his comparison could then be read off on a graduated scale on the back of the instrument. I first gave the instrument with the slide out as far as possible and told the native to slide it in till the lines were equal (okinax). When this operation had been repeated five times, the

\(^7\) Dr. E. Heymans. Arch. f. Physiol. 1896. Supplement Band 8 303.

instrument was given with the slide pushed in and the native was told to pull it out till the lines were "okakin." This was also repeated five times. The slide was in all cases moved with the right hand and the instrument was so placed that the line \( AC \) was horizontal. Several of the natives wished to turn the instrument round or to hold it in other positions but I thought it best that all the measurements should be done with the instrument in one position.

A certain number of men had their blood pressure tested with Hill and Barnard's sphygmomanometer by Mr. McDougall while they were making the observations, for comparison with the results of other kinds of mental and muscular exercise. In these cases the slide was moved and adjusted by myself in response to the wishes of the men expressed by means of the words napi, piripiri and okakin. In Tables XIV, and XV. I have marked the individuals tested in this way with an asterisk, and it will be seen that there was no obvious difference between their measurements and those of the people who adjusted the slide themselves.

The people understood readily what was to be done. As in the case of the illusion already described, a sharp look-out had to be kept to see that they did not measure with their fingers or with a piece of grass. After they had finished, the natives were asked to point out the lines they had been making equal and if there seemed to be any doubt, they were asked to measure so as to make sure that they had understood. There were two chief dangers. A native might notice a mark or irregularity on the lower surface in one measurement and make use of it as an indication in his future measurements. One native who made \( BC \) exactly the same length in several successive measurements was probably going by some indication of this kind. The other danger was that they might think they had to make \( DC \) equal to \( AB \). I have met with this mistake in English children as well as in Murray Island and a few unsatisfactory results which I obtained in Murray Island, before I was alive to this danger, may have been due to this error. The line of junction of the two parts of the instrument should be as inconspicuous as possible, but unfortunately in my hastily prepared instrument, the bevelled edge of the sliding portion was somewhat too obvious. I have found that English observers sometimes notice the length of \( CD \) in one measurement and are influenced by this in succeeding measurements, thus making their mean variations smaller than they would otherwise be.

In Table XIV. the figures in column \( A \) give the average of the whole ten observations; those in column \( B \), the average of the first five when moving the slide from without inwards, the next column gives the mean variation of these five observations; column \( C \) gives the average of the five observations when moving from within outwards and the next column the mean variation of these.

It will be seen that all the individuals made \( BC \) considerably shorter than \( AB \), the average length of \( BC \) being almost exactly \( \frac{3}{4} \) of \( AB \), i.e. the two lines appeared equal to these natives when their real lengths were as \( 4:5 \).

The observations of a few individuals are not included in this table. Three men made \( BC \) longer than \( AB \), their average results being 822, 799 and 894. One of these was a very dull youth who probably misunderstood but the others were good observers. They were, however, among the first cases I examined and I am afraid
that I may not have been sufficiently on my guard against the danger already mentioned of making CD equal to AB. Their mean variations were also very large, viz. 7.28 and 4.72, 5.2 and 7.04, 4.0 and 8.06; and it would be misleading to include them in the Table.

**Table XIV.**

**Murray Island men.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>A</th>
<th>B</th>
<th>m.v.</th>
<th>C</th>
<th>m.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wone*</td>
<td>50-55</td>
<td>58.4</td>
<td>60.0</td>
<td>480</td>
<td>48.8</td>
<td>1.76</td>
</tr>
<tr>
<td>Musa*</td>
<td>45-50</td>
<td>49.8</td>
<td>51.2</td>
<td>936</td>
<td>48.4</td>
<td>0.96</td>
</tr>
<tr>
<td>Pupe*</td>
<td>40-45</td>
<td>50.8</td>
<td>52.6</td>
<td>312</td>
<td>48.9</td>
<td>4.19</td>
</tr>
<tr>
<td>Magi</td>
<td>40-45</td>
<td>64.7</td>
<td>69.6</td>
<td>256</td>
<td>62.8</td>
<td>1.41</td>
</tr>
<tr>
<td>Fali Gara</td>
<td>25-40</td>
<td>61.1</td>
<td>62.2</td>
<td>652</td>
<td>61.0</td>
<td>0.40</td>
</tr>
<tr>
<td>Feye Wall*</td>
<td>20-40</td>
<td>64.1</td>
<td>68.8</td>
<td>294</td>
<td>68.4</td>
<td>1.92</td>
</tr>
<tr>
<td>Bora</td>
<td>25-40</td>
<td>64.6</td>
<td>66.2</td>
<td>326</td>
<td>63.6</td>
<td>1.60</td>
</tr>
<tr>
<td>Dick Tuil*</td>
<td>30-35</td>
<td>69.0</td>
<td>67.8</td>
<td>273</td>
<td>58.2</td>
<td>1.43</td>
</tr>
<tr>
<td>Nako</td>
<td>30-35</td>
<td>55.8</td>
<td>55.2</td>
<td>254</td>
<td>41.8</td>
<td>3.95</td>
</tr>
<tr>
<td>Doba</td>
<td>30-30</td>
<td>59.5</td>
<td>61.2</td>
<td>224</td>
<td>57.4</td>
<td>5.2</td>
</tr>
<tr>
<td>Beni</td>
<td>25-30</td>
<td>64.6</td>
<td>62.8</td>
<td>128</td>
<td>58.8</td>
<td>7.2</td>
</tr>
<tr>
<td>Loko</td>
<td>25-30</td>
<td>65.9</td>
<td>72.9</td>
<td>480</td>
<td>50.6</td>
<td>9.76</td>
</tr>
<tr>
<td>Jimmy Warlu</td>
<td>25-30</td>
<td>59.2</td>
<td>61.0</td>
<td>340</td>
<td>56.6</td>
<td>2.72</td>
</tr>
<tr>
<td>Metti</td>
<td>25-30</td>
<td>63.2</td>
<td>64.4</td>
<td>1.98</td>
<td>62.0</td>
<td>1.90</td>
</tr>
<tr>
<td>Komaberi</td>
<td>15-30</td>
<td>64.7</td>
<td>65.2</td>
<td>1.92</td>
<td>64.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Donita</td>
<td>19</td>
<td>57.6</td>
<td>58.8</td>
<td>204</td>
<td>50.4</td>
<td>1.28</td>
</tr>
<tr>
<td>Maba</td>
<td>18</td>
<td>69.1</td>
<td>62.8</td>
<td>36</td>
<td>56.9</td>
<td>1.20</td>
</tr>
<tr>
<td>Boda</td>
<td>17</td>
<td>63.6</td>
<td>65.6</td>
<td>306</td>
<td>60.6</td>
<td>1.36</td>
</tr>
<tr>
<td>Beche</td>
<td>17</td>
<td>68.8</td>
<td>70.6</td>
<td>340</td>
<td>62.6</td>
<td>2.36</td>
</tr>
</tbody>
</table>

The figures of another man, Tapan, are also excluded. His figures were A 74.9; B 74.7, m.v. 4; C 75.0, m.v. 8. He was almost exactly right every time. He was, however, the first individual whom I tested and it is possible that he was using a mark or some other indication on the slide and unfortunately I did not test him on a second occasion.
One very striking result of these observations is that the final measurement is influenced to a considerable extent by the position of the slide at the beginning. When the part $BC$ of the figure is shortened till it appears equal to $AB$, the former is made consistently (by all except one man) longer than when the apparatus was presented to the native with the slide pushed in, so that $BC$ had to be made equal to $AB$ by lengthening it. The result is of exactly the same kind as was found in the process of eye measuring (see p. 101).

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>$D$</th>
<th>$C$</th>
<th>$m.v.$</th>
<th>$E$</th>
<th>$m.v.$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uli</td>
<td>45-50</td>
<td>697</td>
<td>646</td>
<td>624</td>
<td>686</td>
<td>405</td>
</tr>
<tr>
<td>Jimmy Dai</td>
<td>45-50</td>
<td>684</td>
<td>649</td>
<td>712</td>
<td>734</td>
<td>155</td>
</tr>
<tr>
<td>Wensigi*</td>
<td>40-45</td>
<td>628</td>
<td>604</td>
<td>622</td>
<td>650</td>
<td>26</td>
</tr>
<tr>
<td>Captain</td>
<td>40-45</td>
<td>723</td>
<td>674</td>
<td>622</td>
<td>773</td>
<td>64</td>
</tr>
<tr>
<td>Pat*</td>
<td>40-45</td>
<td>503</td>
<td>532</td>
<td>216</td>
<td>594</td>
<td>198</td>
</tr>
<tr>
<td>Kaige</td>
<td>35-40</td>
<td>642</td>
<td>630</td>
<td>16</td>
<td>654</td>
<td>132</td>
</tr>
<tr>
<td>Jimmy Biz</td>
<td>35-35</td>
<td>647</td>
<td>680</td>
<td>352</td>
<td>628</td>
<td>144</td>
</tr>
<tr>
<td>Dick Tai</td>
<td>35-35</td>
<td>627</td>
<td>524</td>
<td>288</td>
<td>550</td>
<td>16</td>
</tr>
<tr>
<td>Jimmy Wallu</td>
<td>25-30</td>
<td>508</td>
<td>364</td>
<td>336</td>
<td>632</td>
<td>176</td>
</tr>
<tr>
<td>Delfrai</td>
<td>20-25</td>
<td>637</td>
<td>637</td>
<td>136</td>
<td>613</td>
<td>64</td>
</tr>
<tr>
<td>Baci</td>
<td>17</td>
<td>629</td>
<td>604</td>
<td>278</td>
<td>669</td>
<td>296</td>
</tr>
<tr>
<td>Average</td>
<td>62.46</td>
<td>61.28</td>
<td>2.87</td>
<td>65.54</td>
<td>1.84</td>
<td></td>
</tr>
</tbody>
</table>

When a variable length is made equal to a standard, there is a distinct tendency towards a positive error if the former is made equal by a process of shortening and towards a negative error when made equal by a process of lengthening.

This constant result with the Müller-Lyer illusion would seem to show that in making the two lines apparently equal, the natives were influenced by the idea of the
length with which they had started. There is, however, another possibility. It is possible that the illusion tended to increase as a succession of measurements were made, in which case the smaller length of $BC$ in the second five observations would be due to increase in the amount of the illusion.

In order to find out if this was or was not the case, another series of observations were made in which the order was reversed; the first five observations were made equal by moving the slide from within outwards and the second five from without inwards. The results in Table XV. show the same difference as in Table XIV., the second five observations giving in this case the greater length of the variable line.

Table XV. shows very clearly that the differences in the measurements of the illusion are not due to the order in which they were made. The figures are 62.45: 58.13 in the first series and 63.54: 61.38 in the second and only one man (Jimmy Rice) in the second series departed from the rule. One man, Waddell, made a third series of five measurements beginning with the slide in, of which the average was 63.6, m.v. 1.28. It is difficult to see how the difference can be explained in any other way than by referring them to the fact that the line $BC$ was made equal to $AB$ in one case by a process of shortening and in the other by a process of lengthening.

It may be noted that, except in the case of one man, Ware, in Table XIV., the difference in question occurred in those cases in which the slide was moved by myself, i.e., the difference did not depend on a difference in the motor processes of adjustment. The line $BC$ was apparently seen longer in one case and shorter in the other.

On comparing Tables XIV. and XV, it will be noticed that the illusion seems to have been less marked to the individuals in the second series. The latter were quite as intelligent and careful, if not better, observers than those included in Table XIV. and as will be noticed occurred average mean variations are very distinctly smaller. Three individuals, Jimmy Waddell, Dick Tui, and Bert, were tested twice and came into both series. The observations of the first-named differed very slightly on the two occasions, while in Bert's case the illusion seems to have been more marked on the second trial, his mean variation being also distinctly less. Dick Tui's first measurements are those recorded in Table XV, so that the illusion was less marked in his second observations. The fact, however, that in the latter he did not move the slide himself may have had some influence. The average in Table XV. is distinctly raised by the figures for two men, Jimmy Doi and Captian. The former was one of the most intelligent and conscientious observers in the island, and he performed this measurement with extraordinary care and attention, taking twenty minutes to make the ten observations, and having too a very small mean variation. The illusion seems to have been very slight, especially when moving the slide inwards, but he told me afterwards that he took into account the fact that $BO$ was made up of two parts and endeavoured to make $BO$ and $BC$ together equal to $AB$. Such a procedure would tend to concentrate his attention on the central line so that he would have been less influenced by the other parts of the figure, and the small amount of the illusion may have been due to this. The other man, Captian, made his observations carefully and his mean variation was not very large. I made him repeat the measurement, when his second results closely resembled the first, the figures being—A 733, C 704, m.v. 1.28.
ANTHROPOLOGICAL EXPEDITION TO TORRES STRAITS.

B 782 m.v. 96. I could not discover whether there had been anything unusual in his procedure but it is possible that he may have had the same idea as Jimmy Del. The following tables give the results for ten Murray Island boys and nine girls, the letters having the same meaning as in the previous tables.

### Table XVI.

**Murray Island boys.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>h</th>
<th>b</th>
<th>w.n.</th>
<th>c</th>
<th>m.r.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacob (Goli)</td>
<td>13</td>
<td>63</td>
<td>62</td>
<td>104</td>
<td>684</td>
<td>208</td>
</tr>
<tr>
<td>Pot (Pasi)</td>
<td>13</td>
<td>64</td>
<td>53</td>
<td>272</td>
<td>640</td>
<td>358</td>
</tr>
<tr>
<td>Jimmy Bike</td>
<td>12</td>
<td>56</td>
<td>50</td>
<td>200</td>
<td>586</td>
<td>98</td>
</tr>
<tr>
<td>Captain</td>
<td>11</td>
<td>64</td>
<td>64</td>
<td>600</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Tom (Tara)</td>
<td>11</td>
<td>51</td>
<td>56</td>
<td>272</td>
<td>466</td>
<td>85</td>
</tr>
<tr>
<td>William (Tal)</td>
<td>11</td>
<td>51</td>
<td>42</td>
<td>104</td>
<td>284</td>
<td>128</td>
</tr>
<tr>
<td>Sotier (Goli)</td>
<td>11</td>
<td>64</td>
<td>64</td>
<td>206</td>
<td>622</td>
<td>184</td>
</tr>
<tr>
<td>Maxmore</td>
<td>11</td>
<td>65</td>
<td>78</td>
<td>244</td>
<td>640</td>
<td>249</td>
</tr>
<tr>
<td>Harry (Mame)</td>
<td>10</td>
<td>50</td>
<td>50</td>
<td>400</td>
<td>556</td>
<td>288</td>
</tr>
<tr>
<td>Depers</td>
<td>10</td>
<td>70</td>
<td>80</td>
<td>206</td>
<td>742</td>
<td>144</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>61</td>
<td>66</td>
<td>226</td>
<td>692</td>
<td>186</td>
</tr>
</tbody>
</table>
### TABLE XVII.

**Murray Island girls.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>A</th>
<th>B</th>
<th>m.v.</th>
<th>C</th>
<th>m.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary (Kalu)</td>
<td>14</td>
<td>60</td>
<td>64</td>
<td>88</td>
<td>58</td>
<td>72</td>
</tr>
<tr>
<td>Sikoi</td>
<td>14</td>
<td>62</td>
<td>64</td>
<td>72</td>
<td>62</td>
<td>72</td>
</tr>
<tr>
<td>Maletta (Joan)</td>
<td>13</td>
<td>63</td>
<td>62</td>
<td>72</td>
<td>61</td>
<td>84</td>
</tr>
<tr>
<td>Gedaia</td>
<td>13</td>
<td>62</td>
<td>63</td>
<td>98</td>
<td>62</td>
<td>88</td>
</tr>
<tr>
<td>Net</td>
<td>13</td>
<td>72</td>
<td>72</td>
<td>100</td>
<td>67</td>
<td>70</td>
</tr>
<tr>
<td>Konuru</td>
<td>12</td>
<td>63</td>
<td>62</td>
<td>76</td>
<td>59</td>
<td>90</td>
</tr>
<tr>
<td>Maina</td>
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<td>62</td>
<td>69</td>
<td>90</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Geda</td>
<td>10</td>
<td>63</td>
<td>65</td>
<td>74</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Maletta (Ish)</td>
<td>10</td>
<td>55</td>
<td>57</td>
<td>98</td>
<td>59</td>
<td>80</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>62</td>
<td>64</td>
<td>98</td>
<td>60</td>
<td>94</td>
</tr>
</tbody>
</table>

The boys included in the above table moved the slide from without invades in the first series and in the opposite direction in the second. In addition two boys were tested in the reversed order. Their figures were:

George (Pasi). 45½, In 67½, m.v. 88, Out 44½, m.v. 8.

Jimmy Dusar, 59½, In 67½, m.v. 132, Out 69½, m.v. 232.

There appears to have been no important difference in the amount of the illusion in the children and adults. The mean variations were distinctly smaller than those of the first series of men, though not differing greatly from those of the second series in Table XV. The girls unanimously showed the characteristic difference due to the position of the slide at the beginning of the measurement, but the boys were much less uniform, no less than five out of twelve boys failing to show this feature. It is perhaps interesting that of these five boys, four (Jacob, Jimmy Rice and the two sons of Pasi) were among the cleverest boys in the school, while the fifth Dapena, was more or less exceptional in everything he did. This boy had also the highest result among the children, but he understood perfectly and appeared to make
His measurements in the same way as the others, and his mean variations were each below the average.

In the following table are given the results of observations on English adults and children for comparison with those of the Murray Islanders. I have divided the English adult observers into two groups, the first group (A) being made up of students and others well acquainted with the illusion (who nevertheless, tried not to be influenced by their knowledge), and the second group (B) made up of individuals who had no special knowledge of the illusion, though several were more or less acquainted with the figure owing to its use as an advertisement. As in the case of the other illusion, I have not as yet been able to make observations as people as totally unacquainted with the illusion as were the people of Torres Straits.

<table>
<thead>
<tr>
<th>Table XVIII.</th>
<th>MÜLLER-LYER ILLUSION.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comparative Results</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>A</td>
</tr>
<tr>
<td>------</td>
<td>---</td>
</tr>
<tr>
<td>Murray Island men</td>
<td>19</td>
</tr>
<tr>
<td>Murray Island boys</td>
<td>10</td>
</tr>
<tr>
<td>Murray Island girls</td>
<td>9</td>
</tr>
<tr>
<td>English adults, A</td>
<td>15</td>
</tr>
<tr>
<td>English adults, B</td>
<td>15</td>
</tr>
<tr>
<td>German children</td>
<td>12</td>
</tr>
<tr>
<td>Murray Island</td>
<td>29</td>
</tr>
<tr>
<td>English</td>
<td>49</td>
</tr>
</tbody>
</table>

The three Murray Island groups show a remarkable correspondence with one another, and the three English groups show a similar agreement with one another. The English and the Papuan groups, on the other hand, are distinctly separated. The correspondence and the difference are shown equally well in columns A, B, and C. The close agreement of the different groups of the two sets of observers allows one to attach more importance to the want of agreement of the two sets with one another.
than might perhaps be otherwise justifiable. The illusion appears to be distinctly less marked in Murray Islanders than in the Europeans. This is shown not only by the average but by the maximum and minimum observations, and also by the median observations, which differ but slightly from the averages.

The characteristic relations between the figures in columns B and C came out clearly in every group, i.e. in every group the average measurement when the slide was pushed towards was distinctly larger than when the slide was pulled outwards. The difference was least marked in the Murray Island boys, and the English group who were not especially familiar with the illusion and was most marked in the English children. The English and the Papuan groups, each taken as a whole, show no obvious difference in this respect.

The average mean variations of the different groups in making their measurements show a distinct superiority of the English over the Papuan observers, but it will be noticed that the Murray Island children do not differ appreciably from the English children and the unpractised group of English adults. It is the difference between the Murray Island men and the English group A (all practised observers) which makes the average mean variation of the English observers superior to that of the Papuans. Taking this fact into account, the average mean variations of the Murray Islanders show that they performed the operations involved in the test with a degree of constancy and accuracy, very slightly inferior to an equal number of English people.

All groups agreed in having a smaller average mean variation in the second set of five observations than in the first set. This difference was present in the same degree among the Murray Islanders who reversed the order in which the slide was moved (Table XV). The improvement was slightly greater for the Murray Island than for the English observers, i.e. 29.7 per cent.; 24.4 per cent., and was distinctly more marked in the Papuan than in the English adults. The fact that the mean variation shows a greater decrease in the second set of observations may mean that the Papuans improved more by practice or that they were less influenced by fatigue, shortening of interest and loss of concentration of attention. There can be little doubt that it was the former factor which had the most influence.

As I have already mentioned, the results obtained by my instrument are not to be exactly compared with those obtained by other methods owing to differences in the thickness of the lines, etc. Heymans', however, found that, with a figure, in which the angle of the slanting lines was 30° and their length 20 mm., the illusion amounted to 23.2 per cent. This is less than the amount of the illusion in my English observers, viz. 23.9 per cent., but is distinctly greater than that of the Murray Islanders, viz. 18.5 per cent. Heymans' observations were only made on a few individuals, chiefly professors and students, and the figure given above is the result of one observer. So far as I have been able to find, Finet is the only previous worker who has measured the illusion in a number of individuals. His observations were made on 105 children. He used a different method to that employed by me, and

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1 Hi., cit.
obtained different results according to the size of his model. With a standard line 10 cm. in length, he found that the illusion amounted to 18.8 per cent. in the older children, who varied in age from 10 to 14 years. With a smaller standard, 2 cm. in length, the illusion was still more marked.

In a group of younger children, ranging in age from 7 to 12 years, the illusion was more marked, amounting to 24 per cent.

In Binet's figure the slanting lines were at an angle of 45°, the line with obtuse angles was the standard and that with acute angles was variable. Binet's results cannot be directly compared with mine, but the per centage illusion does not differ in any marked degree from those obtained with my instrument, that for the older children agreeing almost exactly with the Murray Island figures, and that for the younger children agreeing closely with that of my English observers. The average mean variations of Binet's children were very distinctly larger than those of any of my groups, the former amounting in one case to over 20 per cent. of the standard while the maximum mean variation of my subjects, viz. that of the Murray Island adults, was only 41 per cent.

Binet's results, though obtained by a method quite different from mine, showed the same characteristic difference in the measurements according to whether the variable was presented in order of increasing or of decreasing magnitude. Binet found that the illusion was greater when the lines were made equal by a process of shortening. This is exactly the opposite result to mine, but the difference is only apparent, and is due to the fact that the line with acute angles (AB of my figure) was the variable. AB was made smaller when it was presented in order of increasing length than when it was presented in order of decreasing length, the characteristic difference being present in both groups of children and in both the large and small model.

This illusion is most satisfactorily explained by a factor which may be expressed in several ways. Auerbach ascribes it to the influence of instinct vision. The apparent length of the lines AB and BC is influenced by imaginary lines filling the space on either side of the chief line. These will be shorter than the chief line in the case of AB and longer in the case of BC. Auerbach found that alterations in the figure tending to render the chief line more prominent, reduced the illusion, while alterations tending to make the slanting lines more prominent increased the illusion.

Another way of expressing the same fact is to suppose that the idea of the length of the line AB is influenced by the size of the figure as a whole, and similarly with the idea of the length of the line BC. There are other examples of figures in which the appearance of part of a figure is influenced by the appearance of the figure as a whole.

There is no reason why a simple factor of this kind should not influence the Papuan as well as the European. The fact that the illusion seemed to be distinctly less marked to the Papuan than to the European may possibly be due to the fact that the former concentrated his attention more completely on the special task he was given to perform, viz. to make the lines AB and BC equal to one another, and tended to

disregard the other lines present in the figure. The European, on the other hand, probably recognizes at once that he is dealing with more than the simple problem of the relative length of two lines and tends to regard the figure as a whole.

As I have already more than once mentioned, I believe that the consistency of the results in Murray Island was due to the fact that the natives limited their attention strictly to the task they were given to perform, and the explanation which I suggest is in accordance with this belief.

The figures in the last column of Table XVIII, under the heading M.V., indicate the degree of the variation of the individual results within each group from the average result of the group. M.V. is an index of the variability of the individuals within each group.

It will be seen that there is a distinct difference between the Papuans and the English observers, the former having the smaller mean variation, i.e. a number of Papuans gave results which were more consistent with one another than those of an almost equal number of English people, and the group of Murray Island men varied from one another very much less than the group of practised English observers.

This is another example of the fact that in some respects the unpractised and wholly ignorant inhabitants of Murray Island give more consistent results than Europeans practised in psychological observation. In the Introduction I have suggested that the greater consistencies of the Murray Islanders may have been due to their total ignorance and to the fact that they gave their whole minds to the special operation they had to perform, and were not influenced by speculations founded on knowledge, in this case on knowledge of the illusion.

There is, however, another possibility. It is possible that the members of a small isolated community such as that of Murray Island may differ less from one another than the members of a highly complex community not only in physical characters, but in the mental characters involved in such an operation as they had in this case to perform. In general character and temperament we found that the natives of Murray Island differed from one another very widely, but it is possible that in the simpler mental features they may present more uniformity than is found among the members of a highly civilized community.

The whole subject is obviously an extremely complex one which I hope to consider in a future Report, in which the variability of the natives of Torres Straits will be studied on the basis of all the data, both mental and physical, collected by the Expedition. I must content myself here with a suggestion of some of the factors involved in the problem.

I have in the Introduction stated that the trustworthy of the observations made by the natives of Torres Straits will be shown in most of the quantitative investigations both by the smallness of the mean variations and by the general consistency of the results. The figures given in Table XVIII will, I hope, be held to support this statement. The very slight inferiority to the English observers in accuracy as shown by a comparison of the average mean variations (m.v.) and the remarkable

1 It is true that the observations of four individuals were excluded from the Murray Island group (see p. 138), but these observations were so obviously unsatisfactory that it would not have been fair to include them.
correspondence of the three Murray Island groups with one another would have been impossible if the Murray Islanders had not applied their full attention to their tasks or if they had failed to understand what they were told to do.

OTHER VISUAL ILLUSIONS.

In addition to the quantitative observations made on the two examples of visual illusion, rough observations were made with several other examples with the object of ascertaining whether the illusion was present or not. For this purpose I used the collection found in the "Pseudoptiques" sold by the Bradley Martin Co. I may mention in passing that the natives were extremely interested in many of the experiments which can be shown with this collection, and anyone living among uncivilized races would probably find the collection very useful in interesting and amusing natives quite apart from any scientific aim.

Care had naturally to be taken not to suggest the illusion and the natives were therefore asked first simply to describe what they saw or were asked if there was any difference in different parts of a figure. Several of the natives showed their appreciation by measuring as they had done in the cases of the quantitative observations already described.

In showing Zollner's and the allied figures, I pointed to different parts of Fig. 3, and to the middle and ends of the parallel lines in Fig. 4 and Fig. 5, and asked if the distances were okakia (equal) or not. Several natives described different (really equal) distances as tampei (short) or piripiri (long) quite in accordance with the normal appearance of the illusion, and some illustrated the apparent divergence and convergence of the lines by gestures which left no doubt that they saw the illusion. This was the case, not only with intelligent young men and boys, but also with two of the elder men, Unai and Sina. On the other hand, Pua, one of the most intelligent men, failed to see or, at any rate, to describe the illusion.

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FIG. 3.
None of the natives observed the apparent difference in the shape of two squares filled with parallel lines when these were vertical in one square and horizontal in the other. Several insisted that they could see no difference, even after leading questions had been put.

There were also many failures to see the illusion in Fig. 6 which is so very marked for European eyes.
No single native saw any difference in the size of a white square on a black ground and an equal black square on a white ground. Very good observers, who saw nearly all the other illusions readily, failed to see any difference here, and I cannot help attaching some importance to this observation and believing that it shows that irradiation was less marked to the Papuan than to the European eye. The question is one of great importance in relation to visual acuity, and if it were established that irradiation is less marked in primitive races, it would help to explain any inferiority in visual acuity which these races show. On the other hand, there is little doubt that irradiation depends largely on the refractive condition of the eye and on the size of the pupils, and it may be that the absence or slight degree of irradiation is associated with one or other or both of these factors.

The illusion of Fig. 7 (known as the chess-board illusion, first described by Münsterberg) was not seen by intelligent natives to whom it was shown. This illusion almost certainly depends on irradiation and it is therefore of interest that it was not observed.

To my surprise the illusion shown in Fig. 8 did not succeed, except in the case of one of the most intelligent younger natives and a Samoan boy. I expected that the man would by all be seen as bigger. Most of the natives, however, took less interest in this illusion than in most of the others; if I had had a similar figure representing two Murray Islanders, I have very little doubt that it would have been most popular and the illusion would also probably have succeeded.
The appearances which were most successfully seen were those of a rotating spiral and of Fig. 9, illustrating visual perception of movement. The after-image appearances after looking at a rotating spiral were described readily and spontaneously by nearly all. I usually told them to look at my face after they had watched the spiral and they were all very excited and amused at the apparent swelling of the face which is seen after looking at inward rotation of the spiral. The men evidently saw the appearance readily and many described it very graphically with hand gestures, and it certainly seemed to me that they saw the appearance more readily than most Europeans to whom I have shown the same experiment. The appearance is, however, materially assisted by a good illumination and this may have accounted for the distinctness with which the natives seemed to see it. The apparent shrinking which follows outward rotation of the spiral was not observed so readily, and by some not at all, and this agrees with my experience among Europeans that the apparent swelling is more readily seen.

Fig. 9

These observations brought out very distinctly the marked individual differences in temperament which one found among these natives. Most were extremely demonstrative and showed their astonishment and amusement in a very obvious manner, while a few looked steadily at the rotating disc and at my face and described the appearances correctly while betraying little interest or amusement as one would expect from the average English rustic.

Another allied appearance which was seen readily by nearly all was that of Fig. 8, the counter movement of the central toothed circle when the whole figure is given a rising movement. In nearly all cases the natives observed the apparent movement of the central part of the figure and described it correctly as being in the opposite direction to that of the surrounding circles and as slower.

When in Mabang, I asked several natives if they had noticed any difference in the size of the sun and moon at the horizon and zenith respectively. Some had observed the difference and some had not. The drawings reproduced in Fig. 10 were made by Warin to show how he saw the sun and moon in the two situations.
It will be noticed that he has not only represented both sun and moon as much larger at the horizon but also as flattened. These drawings add another indication to those already given of the excellent powers of observation of these people.

![Diagram of sun and moon at horizon]

A few observations were made with the object of ascertaining if the natives could observe the existence of the blind spot. For this purpose I used the figures provided in the Milton-Bradley collection. The experiment certainly seemed to succeed with several natives and owing to their power of steady fixation of the eyes (see p. 99) there is no reason why it should not do so. The difficulty was to obtain some kind of control over the statements of the natives and the only one I found practicable was to note the distances from the eyes at which an object was said to disappear and reappear. In the case of several natives, this agreed closely with the distances for my own eyes and I believe that the objects became invisible to these people, though I do not feel the same confidence in this experiment as in the others recorded.

Another illusion on which a few observations were made was that of the appearance of relief of different colours. A black velvet surface was used on which were pasted letters in red and blue, and the natives were asked whether they noticed any difference—whether they were "maile," "muriage," or "okahia" (nearer or farther away or same distance). As is well known, some individuals see red in relief, the colour standing out in front of blue often very considerably, others see blue in front of red, the difference depending mainly on the eccentricity of the pupils, those with nasal pupils seeing blue in front and those with temporal pupils seeing red in front.

Of those tested several saw no difference while several others said they saw blue "maile" and red "muriage;" only one boy saw red "maile." Of four natives who saw blue nearer than red, three had markedly nasal pupils and in another they were slightly nasal; in the fourth the pupils were median. The boy who saw red nearer had median pupils (see p. 11). Unfortunately I had no means of checking their statements, but I am inclined to think that the answers were genuine.
APPENDIX.

By C. G. Seliomann.

THE VISION OF NATIVES OF BRITISH NEW GUINEA.

Visual Acuity.

The E method was employed throughout in the manner already described by Dr. Rivers, except on one occasion at the mission school at Yatomia, where Snellen's test types were used. All observations were made in the open air, either under a verandah or completely in the open. Observations among coast folk were begun at a distance of 15 metres from the type; this was, however, diminished to 12 metres when examining women and inland tribes. As a general rule little difficulty was experienced in making natives understand the process, but three Goris youths who had successfully gone through the tests for colour vision, whether from myopia, stupidity or fear could not be made to understand what was required of them. Similarly a Bulia woman, Derapa, who was quite unusually fat for a Papuan, could not or would not understand, although the process was carefully explained to her in the Bulia dialect. Again, in the very marked case of myopia seen, occurring in a Yule Islander with a reputation for cleverness among the local missionaries, considerable difficulty—which might easily have been mistaken for lack of comprehension—was experienced in persuading the subject to allow himself to be even partially tested.

Another source of falacy was learning by heart, which occasionally was very quickly done. A Motuan who had been educated in the mission school was found to have learnt the lines of No. 5 type after being taken through it twice, and to be able to repeat it correctly with his back turned to it. Another similarly educated Motuan repeated the line backwards correctly after a very short time. An attempt was made to ascertain how this was done, but I was unable to satisfy myself that he visualised the line, though possibly this occurred.

It was several times noted that just beyond the limit of accurate vision the two horizontal positions $\mathbf{u}$ and $\mathbf{c}$ were mistaken for each other, as were the vertical positions $\mathbf{F}$ and $\mathbf{z}$, while a horizontal position was never mistaken for a vertical or vice versa.
ANTHROPOLOGICAL EXPEDITION TO TORRES STRAITS.

Some 50 Papuans, all natives of British New Guinea, were tested. Throughout these observations the ages of the subjects were judged by their general appearance.

At Bulua ten males, all judged to be between 16 and 25, were tested. In all of these V was greater than 5/4. The average visual acuity of seven of these was 20/70, the median 5/4 and the maximum 5/3.

Two male aliens, judged to be about 45, were also examined at Bulua; one of them who had lost one eye could decipher 5/6, the other 5/4, but in the latter case it was not clear that his limits had been reached.

Ten Bulua girls had an average of 15/7, a median of 15/5 and a maximum of 5/3. At Yule Island, as already mentioned, a single instance of myopia was seen; the subject in this case wrinkled his lids and narrowing the palpebral fissure when asked to look at a distant object, as among European myopes. Here too a case of marked hyperacuity of vision, exceeding anything met with in Torres Straits and approaching that of Kotelman’s Kalmucks, was seen. This man could read 6/6 without hesitation, and if it had been possible to test him further would probably have shown even more marked keenness of vision.

Four Yule Islanders, including the above instance of hyperacuity, gave 6/6, 6/5, 6/3. Two Wainana men could read 6/6 and 6/5. Three Motocns examined at Vatokina could read 6/6, 6/7 and 6/8 respectively. Of inland tribes, nine Sinangolo men had an average acuity of 6/8, a median of 6/7, a maximum of 6/6. The acuity of two Sinangolo women was 6/5 and 6/4.

Six hill men from the Sogeri country, some 25 miles inland from Port Moresby, were examined. Five of these gave 6/5, 6/5, 6/5, 6/6; the sixth man could easily read 6/3, probably about 6/4 represented his visual acuity.

Two Tatalako men could both read 6/5, a third (unfinished) could read 6/4 but not 6/3. Owing to their nearness to civilization and the case with which their attention was distracted it was not found possible to determine with absolute accuracy the visual acuity of the members of the last two tribes. It is however believed that the above figures may be taken as approximately true, but erring perhaps on the side of unduly diminishing their visual acuity.

It will be readily seen from the above figures that the visual acuity of members of coast tribes was generally greater than that of inland folk. Omitting the Sogeri and Tatalako men there remain nine Sinangolo men examined under the most favourable conditions with an average visual acuity of 6/6 against seven Bulua men with an average acuity of 5/6 and, excluding a marked myope, a mixed group of 14 coast men from Bulua, Port Moresby and Yule Island with an average acuity of at least 6/6.

The following table, of the same nature as that already given by Dr Rivers (p. 25), further brings out these differences.

As regards sexual differences ten Bulua girls and women had an average visual acuity less by 2-3 metres than the average of seven Bulua men, while among the Sinangolo the only two women examined were within a metre of the average of nine men. Although the above numbers are too small to allow a definite opinion, it would appear that at Bulua at any rate, the visual acuity of women was less than that
of the men. It is perhaps noteworthy that the average of the Bulsa women agrees closely with that of the Murray Island girls tested by Dr Rivers, while that of the Bulsa men is distinctly superior to that of the Murray Island men. This might be regarded as an expression of smaller racial variability among women, but it must be remembered that all the Bulsa men were young and that

<table>
<thead>
<tr>
<th>Tribe</th>
<th>No.</th>
<th>Average acuity</th>
<th>P = 1 or &lt;1</th>
<th>P = 1 to 2</th>
<th>P = 2 to 3</th>
<th>P = 3 to 4</th>
<th>P = 4 to 5</th>
<th>P = 5 to 6</th>
<th>P = 6 to 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yale Island and Waima</td>
<td>7</td>
<td>385</td>
<td>57-1</td>
<td>0</td>
<td>0</td>
<td>14-2</td>
<td>71-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mota</td>
<td>2</td>
<td>11-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Bulsa g</td>
<td>10</td>
<td>0</td>
<td>30</td>
<td>50</td>
<td>10</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Bulsa f</td>
<td>10</td>
<td>0</td>
<td>40</td>
<td>50</td>
<td>10</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Total cool tribes</td>
<td>30</td>
<td>62</td>
<td>56-6</td>
<td>106</td>
<td>33</td>
<td>59-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simangalo</td>
<td>9</td>
<td>11-4</td>
<td>77-7</td>
<td>11-1</td>
<td>0</td>
<td>0</td>
<td>89-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kpeli</td>
<td>6</td>
<td>165</td>
<td>63-6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>58-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tatitara</td>
<td>2</td>
<td>62</td>
<td>37-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>38-3</td>
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<td></td>
</tr>
<tr>
<td>Total inland tribes</td>
<td>18</td>
<td>222</td>
<td>72-2</td>
<td>55</td>
<td>0</td>
<td>0</td>
<td>77-7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dr Rivers found that in Torres Straits the visual acuity begins to fall off at an early age. If the Bulsa men are compared with the Torres Straits men between the ages of 15 and 35 (see Table II. on p. 28) there is no marked difference between the two groups.

**Colour Vision.**

Holmgren's wools were employed, the three test-wools commonly used being, at Dr Rivers' suggestion, supplemented by the four others which he had found useful (p. 49), while the process of examination was as far as possible identical with that employed by him.

Thirty-four men, one an albino, and five women were examined, all readily appreciating what they were required to do. There seemed little tendency to fall together wools to which the same name would be applied, and with the exception of O6, a native of Bulsa, no real difficulty was experienced by anyone in matching the test wools. The Simangalo and Tatitara tribes were specially quick and correct, a point of interest, since the former have the most incomplete and indefinite colour vocabulary met with in British New Guinea.
The Bulas natives were perhaps the least accurate; people was generally matched slowly and after much hesitation, while the green type was commonly matched with greens or green-blues of varying saturation. Ola may be taken to have had some degree of colour-blindness, although on being given a pale green or yellow wool he matched either easily enough. Red was matched quickly and correctly, then after some hesitation violets and purples of about the same saturation were placed by the type. Pink was matched with a number of blues and violets mostly more saturated than the type. On being asked to name the colour of this test he said naraa, the term applied by his fellow tribesmen to blues and blue-greens. The blue type was matched with a pink wool of about the same saturation, while a pale mauve test was placed by the side of more saturated pinks and blues.

Definite names for red, white, and black, were found everywhere, and purple was almost always called by the same name as red.

Orange and yellow commonly had a name of their own, while the names for the other colors were often vaguely defined and indefinitely applied. This was most marked amongst the Sinangolo—an inland tribe to the Ilugs district—where dahabu, black, said to be derived from deba, a dark cloud, or icwaaw, rainbow, gave the names commonly given alike to green, blue, indigo, violet, and black. Nearly everywhere all colour names were identical with, or formed from, the names of natural objects, and this explains the fact that the rare colour names, used by only a few of the individuals questioned, were usually understood by the rest of the village.

Eastwards of Yule Island, as far as Bulas, colour names were for the most part formed by reduplication; and this was especially marked for those colour names which were most definitely applied. Over this area reduplication is used to suggest intensification of the most obvious or important qualities of an object; thus at Bulas where talaum meant fire, kalokalakonne besides meaning red was employed to signify glowing ember, while among the Sinangolo where kulo signified the white cockatoo, kalokulo meant both white and the distinguishing head-dress made of cockatoo feathers worn only by successful kahukids. Rarely among the Motu the name for a definite and saturated colour would be qualified by the slowly dawled adjective momo, meaning plenty, and probably in a colour sense used to express pure or very. This was perhaps done by way of qualification, and it seemed desirable whether the people would understand themselves make use of this, one of their favorite adjectives, in describing a colour.

Among these people, who employ reduplication extensively, the affix -a is used to diminish the force of a colour name, and has the signification of our -id. It was, however, difficult to realize what might be reduplicated, when it seemed that it had all the force of the reduplication of the original term; thus gadosgodaka and gadosgados seemed to be indiscriminately applied to the same object.

Eastwards of Yule Island reduplication played a small part in colour nomenclature, and at West, according to the late Fée de Breyde—a most careful observer—gave the force of the affix -id.

It is probable that an exception to this generalization will be found among certain island tribes in the neighborhood of Port Moresby. An attempt to obtain colour names from some Sepi and Russel men resulted in lists of words which showed little trace of reduplication.
APPENDIX.

As far as could be determined, there was the same absence of reduplication among the Toreri and other Gulf tribes, but it was found by Dr. River to occur among the Western Papuans of Kiwai and at Murray Island in Torres Straits.

As regards the objects from which colour names were derived, the sea, as far as could be determined, played an important part only among the Motuanas and among the coast folk at Bulaa, both of whom are essentially fishing folk. The former people, besides deriving their words for green and blue from the sea, have as their word for black the reduplicated name of a black holothurian common on the reef, this being the only example of a coast people east of Cape Possession where the word for black was not commonly derived from the universally employed mourning pigment—made from burnt coconut husks—although this substance was so used among them.

Throughout the Moko district the word for red was the name for the female of the parrot, Eclectus polybleucus. At Bulaa the term for this parrot was verala, and the same word was applied to its tail feathers, which were much in demand for dancing head-dresses, especially when their red colour had been rendered yellow by prolonged feeding for three or four years with roast food to which a species of ginger had been added, and this name was occasionally used to designate an orange-coloured paper.

This is an interesting example of the origin of a colour name from the same object among people who could scarcely have come into contact with each other. Another widely spread example was the word for black, which, as already stated, among most of the tribes investigated was derived from burnt coconut husks. In the Western Tribe of Torres Straits the common term for black was similarly found by Dr. Rivers to signify charcoal.

At Bulaa red was called kowakalova—literally glowing embers—by all of the six men examined separately and the same term was applied to purple by all except Ola, who called it marrawa, and, as already mentioned, was probably to some extent colour-blind.

Yellow and orange were called polapa—pols, turmeric—rarely kowakalova or verala—the name for the female of the parrot Eclectus polybleucus—or lupalupa—explained as the colour of a Papuan's skin, and perhaps the same as diba, a black cloud. Moreover, the term for rapa human skin, was also used.

The various shades of green and blue, including indulge, were generally called marrawa-marrawa from marrawa the deep sea, such more rarely lupalupa, polapa, kavakavu (wood ashes) and even once kalova.

Violet was called tulomilo, meaning the burnt hank of the coconut, which when made into a paste with water, is smeared over the body as a sign of mourning, less commonly lupalupa or marrawamara.

Black was also called mibula and rarely lupalupa.

White was always called kalakula, from kalu, the white coralline. Kesiikesi, explained as the colour of a linewashed wall, was also said to be used.

Among the Motuanas of Port Morea, red, purple, and rarely orange were called kakakuka, the term mibulubura from rabura, turmeric, being usually applied to orange and yellow.

II, 11.
Green and yellow-green were called gudongdo from gudo, the deep sea. All shades of green, green-blue, and blue being often called gudoko or gudogudoko, the suffix sa having the force of the termination -sa.

Indigo and violet, occasionally derived from godo, were generally called bununu, literally 'dye.'

Black was called koremakoren; the unredeuplicated word being the name for a black holothurian commonly found in shallow pools.

White was called kule kule from kule, the white cockato.

Among the Simanggol red and purple were invariably called kaharakakana, and this term was usually applied to orange, which was rarely called boromb (bora, turmeric) or paina.

Yellow was always called boromb as, for the most part, wore the yellowish shades of green, though these were sometimes termed merumans, from the colour of ripe banana skin, kulekule, or magetla korekore, the term for a special kind of banana leaf.

Green was called by noy of these terms, except boromb, and it was sometimes termed kowau, meaning rainbow. Brilliantly green banana leaves were however called dubuduba, dubudubua, or dubana kuuka from duba, a dark cloud, and Mr A. C. English, Government Agent for the Rigo district, to whom my best thanks are due for much kindly aid in drawing up colour vocabularies of the Simanggol and Bulan tribes, tells me that the former habitually use any of these words to describe the vivid green of a flourishing banana crop. Green-blue was usually called dubaduba, less often boromb or merumans.

Blue and indigo, commonly called dubaduba, were sometimes called kowau or magetla korekore, while indigo was once called guruma, the name for the black pigments used as already described as a sign of mourning.

Black was called dubaduba, dubese or dubudubua.

White was called kule kule from kule, the white cockato.

The remaining three vocabularies—for those of Moka and Rabau are so much alike that they may be regarded as one—are from the Melco district. Innowahi is inland some 10 miles up the Anglabanga (St Joseph River). Its colour names, with the exception of that for black are entirely different from those current among the coastal tribes of Raro, Moka, and Wauma. On the other hand, its terms for red and violet are closely similar to those in use for these colours at Tatikara, an inland village on the Biau river in the Papuan Gulf district. The tribal history of Tatikara, as well as various objects obtained there, suggests that this may be explained by their being more closely related to the natives living on the banks of the higher reaches of the St Joseph River than to the coastal folk of the Gulf who are their nearest neighbours and with whom they have largely intermarried. At Wua, which is a collection of family groups spread over a considerable area where there is probably a strong Gulf element, the colour names obtained were of the Melco coast type. Possibly if individuals of the different constituent groups were carefully and separately questioned, it would be found that the colour vocabulary varied and names skin to those of the Gulf might be obtained.

At Rabau, or Yulu Island, red and purple were called boro (Emetius polychlorus, female), never awaisi, turmeric, which was strictly limited to yellow and orange. The
pink wool was once called brocas porena, i.e. red-white. Green, blue, violet and black were commonly called uma or umun—mourning pigment—and these were the terms invariably applied to the green of coconuts and banana leaves; rarely were green and blue called ariai. White was called pone. These people belong to the Rero tribe.

The Mohn names were for the most part formed from the above by adding the suffix zu.

At Waima only three men were questioned. Red was called hiro, also opo, red ochre, and iruba, flame, the latter name being also applied to the brilliantly red stems of a species of Ricinus. Purple was also called hiro or bre-bre; and a red wood was once called hiro t-ohana, meaning pure red, to distinguish it from purple. Orange and yellow were called aisitu, turmeric. Green, blue and violet were called eokoa. Black was called uma (mourning pigment) or wapum (right, also perhaps dark, darkness). Uma was not suggested, and, as far as the late Père de Breycke knew, was not used for green or blue; it is however probable that examination of a larger number of individuals would show some such use of uma. As in Yele Island, white was called pone.

At Inuakau a few colour names were obtained. Red was called piecanga, perhaps also lifi, blood, which was the term applied to purple. Orange and yellow were called isadanga. Green was called kulan kua, said to be the name for the skin of a green frog. Blue and black were called umangata, from uma, the mourning pigment. Violet was called umuni, which is probably another form of the same word or may possibly be the name of a fruit. White was called kelanga.

1 Oros (Les Marianes Catalognes, 1898, page 179) gives choko as a Yale Island term for green and mentions the word ronoi as used for chestnut and notes that white hair is called caii. He further notes that the sky and belly of fish are both called uma, black.
Of Tatikaro colour-names bitonga may be assumed to be the same as the Inawabui pitoa, similarly onini and onauga—stated to mean blue and black respectively—are probably the same as amini and umonga. The terms for orange and yellow, dampa, green, aung, and white, hihi, do not on the other hand seem to be related to any of the Mekeo terms.

At Jokea meuru applied to blue, violet or black is probably the same as the Tariapi meuru, a dark cloud; while the few Jokea colour-names obtained closely resemble those of Tariapi.