Studies in race crossing. IX. Crosses of Australians and Papuans with Caucasians, Chinese, and other races

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Having made many studies of race crossing in different parts of the world, the principles of racial genetics have gradually been built up (see Gates 1959a). These principles contrast strongly with those of medical genetics (Gates 1946). They are more complicated because racial characters depend on multiple genes, generally with cumulative effects rather than clear dominance, whereas the abnormalities which occur as mutations in all races are based on single genes which can be dominant, recessive or sex-linked in inheritance in different families of the same race.

An expedition for the genetical study of Australian aborigines and Papuans has already (Gates 1960) placed the aborigines in a new light in which the skin colour genetics is shown to be entirely different from that of the African Negro and much nearer that of Europeans. Instead of four genes for skin colour (in the Negro) there is in the aborigines a single main gene for melanin production, with a minor gene producing brunet-white skin coloration. Much of the aboriginal skin colour is moreover produced directly by tanning or exposure to the sun.

Crosses of Papuans with Europeans, to be described in this paper, show that the Papuan skin colour genetics is similar to that of the Australian aborigines. Moreover, the F_1 hybrid of this cross is surprisingly like the Caucasian type in many respects. Racial crosses in which Chinese men are involved show the remarkably strong inheritance of the Mongolian brachycephaly.

At Port Darwin, in the Northern Territory of Australia, many observations of racial crossing were made. Some of the results are detailed in Table I and may be considered here. The public school contained many children of mixed parentage involving a number of racial types. Indeed, there are few places where a wider range of racial mixtures can be found. Darwin is about 1000 miles northwest of Alice Springs, and the bus journey occupies three days, stopping in isolated small hotels at night. The seven families whose characters are recorded in Table I were all in the vicinity of Darwin. Generally the father and frequently the mother was unavailable for study, so that in several families the children (sibs) only were studied. But in every family the racial ancestry of the parents was determined. Each family chosen showed some marked feature of racial inheritance.

In family I the ancestry is shown in Text-figure 1. It may be explained that in

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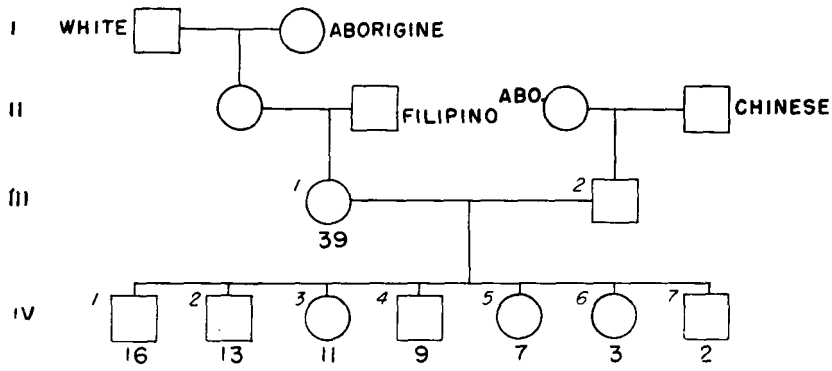
all the text-figures squares represent males, circles females. The generations are numbered at the left, in Roman characters, while the figures below the individual symbols represent the ages in years, and the figures above the squares and circles are consecutive in each generation. Thus in Text-figure 1, IV. 3 represents the third child in the fourth generation of this pedigree. It will be seen that the pedigree of



Textfigure 1

the mother (III. I, 39 years old) of the family in Text. fig. 1 began with an F_1 of Australian aborigine and White, having had a White father and a pure aboriginal mother. Their daughter married a Filipino, whose daughter (III. 1) thus combined three races. Her husband (III. 2) was an F_1 of Chinese and aboriginal. He contains equal measures of aborigines and Chinese, being heterozygous for all the aboriginal and all the Chinese racial characters. The seven children (generation IV) thus combine various ingredients of four distinct races, the fourth "race" (Filipino) being of mixed origin, variously compounded of Malay, Spanish and Chinese elements. The mother is shown in Fig. 1 with her two youngest children. In Table 1 the eye colours are those of the Martin Augenfarbentafel; 4, for example, is very dark brown. The skin colours follow the Gates colour chart, though with these races they seldom correspond exactly, this chart having been constructed from the African races. The colours under "skin" are therefore only approximations, but near enough for present purposes. The black hair of the mother is nearly straight, perhaps from the Filipino father. Her head shape (C.I. 78.4) is near the border of brachycephaly, probably from the same source.

The eldest son (IV. 1, Fig. 2) like his mother, has black, nearly straight hair, but darker skin. His grandmother on his father's side and his great-grandmother on his mother's side were both pure aborigines. This is the source of the marked brow ridges with sunken orbits. He is markedly dolichocephalic (71.4), in extreme contrast with the brachycephaly of his sibs (Table 1), a feature inherited from his

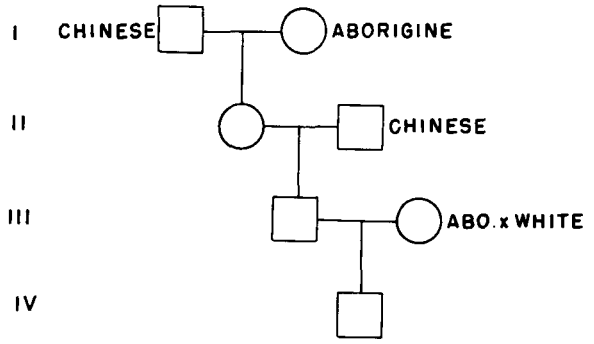
two aboriginal grandmothers. The second son (Fig. 3, left) has similar black hair, somewhat lighter skin, but a broader face combined with high brachycephaly (87.6) derived from his Chinese grandfather. His partly sunken orbits will be from his aborigine ancestors. The eldest daughter (IV. 3, Fig. 4, left) has very dark brown, straight hair, with dark brown eyebrows and eyelashes (black in her brothers). Her skin colour is slightly lighter, but she is also markedly brachycephalic (C.I. 84.5). She has small ears, no brow ridges, orbits not sunken, top eyefold (from Chinese grandfather), nasal root ½-depressed. The 9- year-old son (IV. 4, fig. 3, right) has black hair, eyebrows and eyelashes like his brothers, skin colour slightly lighter than his elder sibs, orbits not sunken, top eyefold. The next daughter (IV. 5, fig. 4, right) has hair like her sister (IV. 3). She is very brachycephalic (85.5), with nasal root much depressed, orbits somewhat sunken, top eyefold, but her nostrils are narrow. She has inherited from her White great-grandfather the genes for narrow nose. The two youngest children are in their mother's arms. The daughter (Fig. 1, left) has light brown curly hair probably from her White ancestor. The nasal root is depressed but the orbits are not sunken and the eyefolds are marked. The youngest son (IV. 7, Fig. 1, right) also has a depressed nose, with the top eyefold and narrower nostrils, but his orbits are partly sunken (aboriginal). (The heads of the two youngest children were not measured).

It is thus evident that each of these children is a mosaic of racial characters derived from White, aborigines or Chinese. The Filipinos, being a secondary race derived from Malay, Chinese and other elements, can hardly enter into this analysis. It will be seen that at least five of the seven sibs inherited the top eyefold from their paternal grandfather. Four of them also inherited his high brachycephaly, although the eldest displayed instead the high dolichocephaly of his aboriginal ancestors. The genetic segregation is thus strongly marked for various racial characters, although other evidence shows that each character depends on a small number of genes with cumulative effect. There is no clear evidence in this family of linkage between different racial characters, although it is possible that such linkage exists.

In family 2, the father (Fig. 5) was three-quarters Chinese, one-quarter aborigine, as shown in Text-fig. 2. His characters are recorded in Table 1. His markedly Chinese appearance results from his broad face, black hair, but somewhat wavy (from his aboriginal ancestry) eyefolds, broad head (rather than short), giving him high brachycephaly (88.3). His skin colour is a combination of the light yellowish Chinese with the mahogany-brownish aborigine (one gene) plus a certain tanning effect. The small son (in the father's arms) had a mother who was of mixed aborigine-white descent. She could not be measured. The child has much lighter skin colour than the father, his hair is dark brown rather than black and he is definitely brachycephalic (80.8), though much less so than his father. He has, moreover, narrow nostrils and no eyefolds (characters of the White race).

Family 3 (Table I) consists of four sibs, shown in Fig. 6. The mother of this family was aborigine, the father mixed white. The eldest son has closely curly, black hair, near-aboriginal skin colour, a mesocephalic head (78.5), no brow ridges but

sunken orbits. His face was long and narrow, chin pointed, nostrils of medium width. The second son (right rear in Fig. 6) has much lighter skin, lighter eyes, hair brown and ± wavy, nasal root not depressed but orbits somewhat sunken (showing that nasal depression and sunken orbits are controlled by separate series of multiple genes). His head is definitely narrower, so that his cephalic index is considerably lower (73.9);



Textfigure 2

and his nostrils are narrower. The third child, a daughter (left front in Fig. 6), has a clear aboriginal aspect, with large mouth, very broad nostrils and ± sunken orbits. But her hair is medium brown, somewhat variegated. The few streaks of light hair are apparently the effect of the gene for tawny hair present in many of the aborigines (Gates 1959). The skin colour is intermediate between that of her two brothers. Her younger sister has darker brown hair, and skin colour lighter than her sister but a shade darker than her younger brother. A marked feature is the everted lower lip in all four children. As pointed out elsewhere (Gates 1960), this condition depends on a single gene and is found at least in the Caucasian and Mongolian races and in the Australian aborigines. It is quite independent of the thick everted lips of the Negro.

The four children in Fig. 7 represent the fourth generation of family 4, whose ancestry (Text-fig. 3) involves three races, aborigines, Malay and European. The segregation of racial characters is very striking in these sibs. At least one of the European ancestors must have had blue eyes and fair hair, which are so marked in the girl (Table I). Unfortunately, head measurements were only obtained of one son. The eldest son (Fig. 7, in rear) has black hair, strongly wavy; dark skin colour (# 3 — # 4), no brow ridges; orbits somewhat sunken, face long and narrow (C.I. 70.6) [1], mouth

[1] The very narrow face and heads in crosses of Malay with Melanesians, Chinese and Tamils was recognized by Hagen (1906). I am not, however, prepared to say that this is true of Chinese crosses for, as we have seen, the Mongolian brachycephaly (broad head) is generally markedly persistent in racial crosses.

Fig. 1. Table I, family 1, mother and two children (Text-figure 1)

Fig. 2. Table 1, family 1, eldest son

Fig. 3. Table 1, family 1, two younger sons

Fig. 4. Table 1, family 1, two daughters

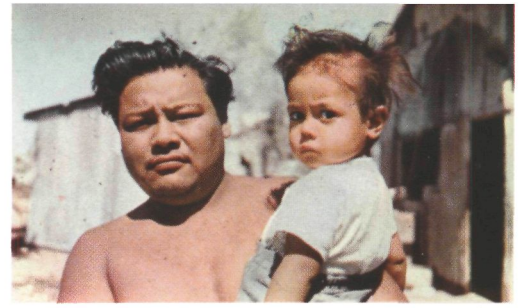


Fig. 5. Table 1, family 2, Father and son (Text-fig. 2)

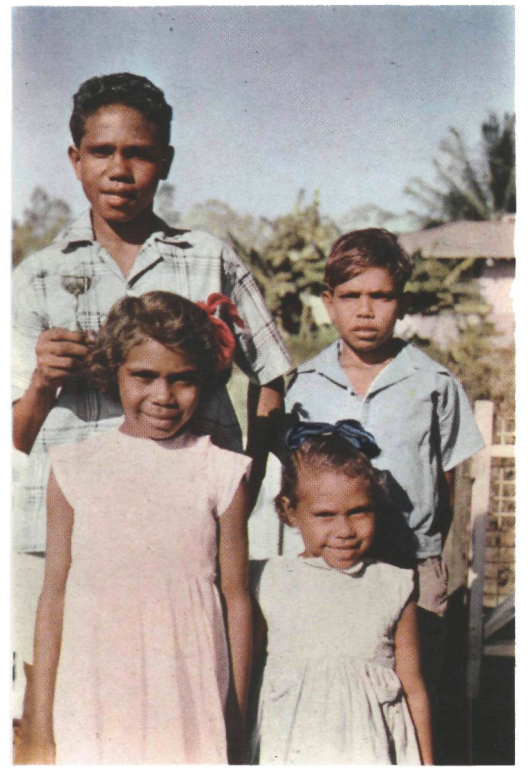


Fig. 6. Table 1, family 3, 4 children

Fig. 7. Table 1, family 4, 3 sons, 1 daughter (Text-fig. 3)

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Fig. 8. Table I, family 5, 2 sons, 1 daughter

Fig. 8A. Table I, family 6, son and daughter (Text-fig. 4)

Fig. 9. Table I, family 7, 2 sisters, aborigine-white descent

Fig. 10. Table II, Grandmother, 2 daughters and 4 grandchildren (Text-fig. 5)

Fig. 11. Table III, First wife and two children

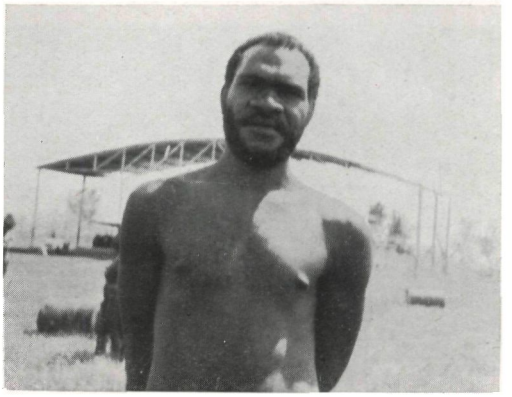

Fig. 12. Table III, Native Papuan from Goroka

Fig. 13. Table III, Second wife and two children

Fig. 14. Table III, Third wife and two children

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Fig. 15, Papuan chief from Goroka

Fig. 18. Table IV, Madang family, F_1 and F_2, Papuan × Chinese

Fig. 16. Table IV. Papuan × White, F_1 and child, Port Moresby

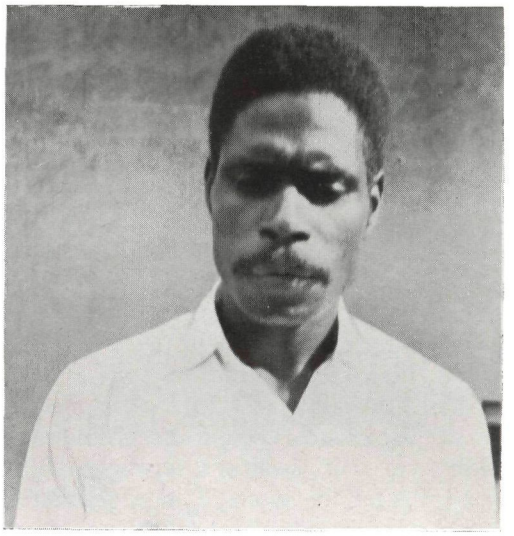


Fig. 19. Table V, Front view, Papuan with White grandfather (Text-fig. 6)

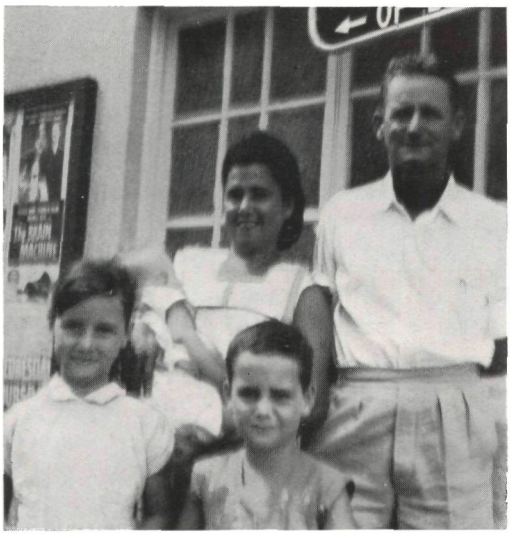


Table 17. Table IV, Same family, husband, wife and three children

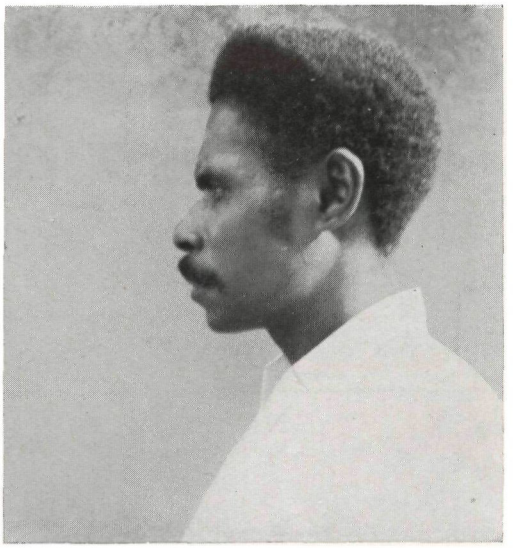
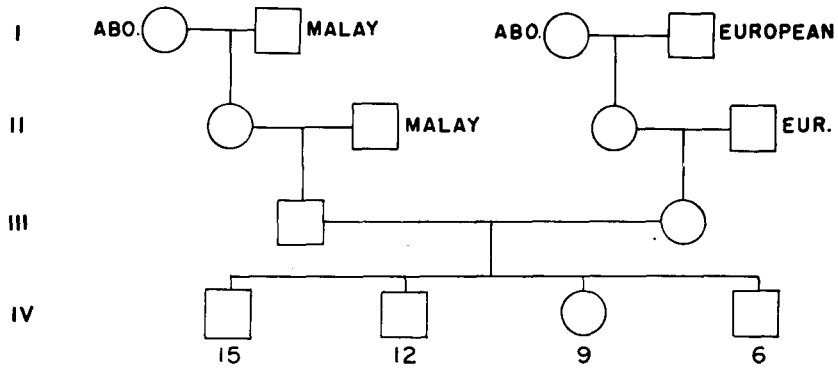


Fig. 20. Table V, Same in side view

rather small. The second son (on right in Fig. 7) has near black, nearly straight hair, skin colour a shade lighter, orbits slightly sunken, broader face. The daughter is a segregate of completely European type, with blue eyes, blond hair and a white skin. Her face is wider than in her elder brother. The only indication of non-European ancestry is the slightly sunken orbits. The three brothers all have very dark eyes.



Textfigure 3

The youngest brother (in front in Fig. 7) has medium brown hair which is wavy to curly; his skin colour is yellow (# 5) face broad, orbits slightly sunken, mouth large.

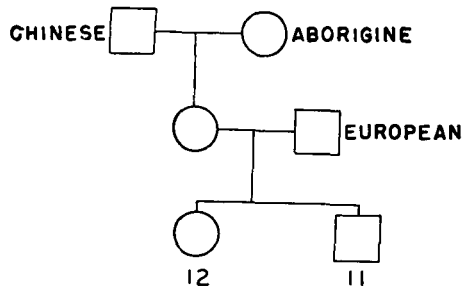
All four sibs agree in having nostrils of medium width, nasal root slightly or not at all depressed, except the youngest boy in which it is half-depressed. The three eldest agree in having a strongly everted lower lip, and the youngest may be heterozygous for this gene. Linked genes for colouring of eyes, hair and skin in the daughter are indicated. This is not an unusual occurrence in the White race, from which this colouring came.

In family 5 the father was White, the mother Japanese. The two boys had light brown, straight hair and yellowish skin colour (Fig. 8). Both were brachycephalic, the younger more so because his head was much shorter. The girl had brown straight hair and a practically white skin, with pretty features. All three show partly depressed nasal root and absence of brow ridges, these features being derived from the mother. The nostril width ranges from broad in the eldest boy to narrow in the girl. The eyefolds are present in the boys and more marked in the girl. The lower lip is everted in the eldest child but not in the other two. This was probably derived from the Japanese mother.

The pedigree of family 6 is shown in Text-fig. 4. An F_1 daughter of a Chinese father and an aboriginal mother married an European and had two children, one of either sex. They agreed in eye colour and hair colour, but the son had nearly straight hair and slightly darker skin colour and was more brachycephalic (83.4), due to a

much wider head (144 mm). The girl was devoid of brow ridges whilst in the boy the nasal root was slightly depressed. Photographs were not made.

In family # 7 both parents are of mixed aborigine-white descent. The dolichocephalic mother had black, wavy, abundant hair, brown eyebrows and black eyelashes, the root of the nose half-depressed. Her skin colour (# 5) was intermediate



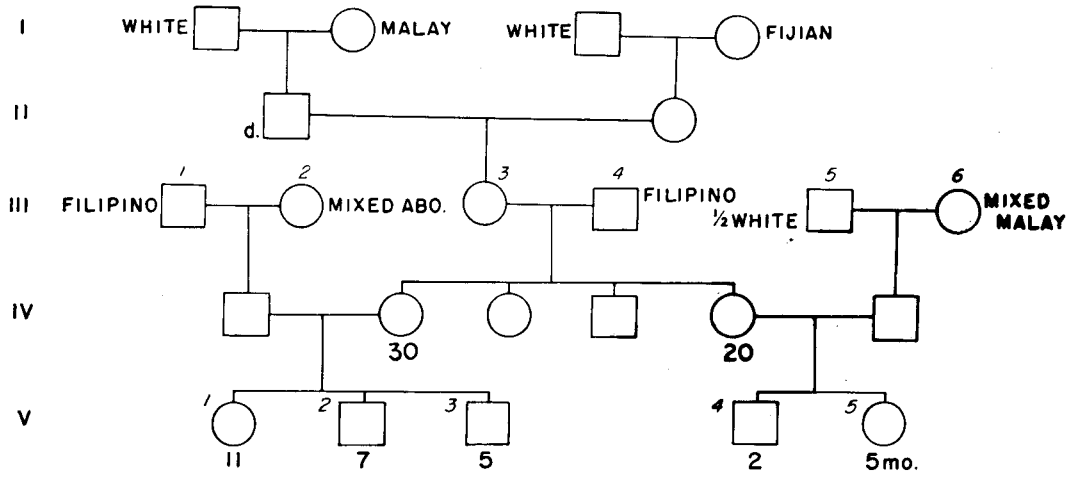
Textfigure 4

yellow. The two daughters (Fig. 9) were markedly contrasted, as shown in the last lines of Table I. The elder child had blue eyes, very light brown hair with brown eyebrows and eyelashes, and a brunette white skin. The younger daughter had very dark brown eyes, medium brown wavy hair, with brown eyebrows, black eyelashes and a darker skin. The slightly depressed nasal root in the younger sister and the ± sunken orbits in both are persistent features from the aboriginal ancestry.

Discussion of results

Each of the seven families in Table I shows certain features of inheritance and genetic segregation of racial characters. These can all be understood on the basis of a very small number of cumulative genes for each character. Certain other points in this Table may be referred to here. The eyebrows are frequently a shade lighter than the eyelashes, which are generally black. Brachycephaly is strongly (but not completely) inherited from a Mongolian ancestor, evidently depending on a small array of cumulative genes. Thus in family 1 the mother is mesocephalic (C.I. 78.4), the eldest son dolichocephalic (71.4), while four other children are brachycephalic (87.6, 84.5, 83.6 and 85.5). The differences here are mainly in *width* of head, and the results can be explained on the basis that the father is heterozygous for a small series of genes producing different degrees of brachycephaly. In this case the Filipino grandfather may also have had genes for brachycephaly. In family 2, the father was three-quarters Chinese and still more highly brachycephalic (88.3). The mother, of mixed aborigine-white descent, must have been dolichocephalic, but their little son is still

brachycephalic (C.I. 80.8). In family 5 the Japanese mother has two brachycephalic sons (81.4 and 86.2), the difference in C.I. being due to shortening (not broadening) of the head. In family 6, which had a Chinese grandfather (Text-fig. 4), the son is brachycephalic (83.7) while the daughter is on the border of brachycephaly (79.8),



Textfigure 5

the other two races involved being both dolicho- or mesocephalic. The difference in C.I. is here due mainly to the head being broader rather than longer.

Most of the children in these families have very small brow ridges or none, but some may perhaps develope them later as adults. On the other hand, the sunken orbits, so characteristic of the aborigines are frequently present in varying degrees in the offspring. A depressed nasal root, equally characteristic of the aborigine skull, may persist more or less independently of sunken orbits although both have frequently been regarded as belonging to a single anatomical feature of the skull. Thus the nasal root may be half-depressed while the orbits are not sunken, or the orbits may be sunken and the nasal root only slightly depressed. In crosses with a Chinese or Japanese ancestor, as in families 1 and 5, the top eyefold generally appears but the epicanthic fold is seldom seen. The large mouth, which is general in the aborigines, frequently occurs in their descendants from crosses with other races. A projecting heel has been observed in certain of the aborigines and their hybrids. Its frequency and significance are not clear. Todd showed many years ago (I have been unable to find again the reference) that in the Negro the projecting heel is not bone but hard cartilage. The inheritance in crosses is unknown.

Table II includes a single family in Darwin in five generations (Text-fig. 5) and four different races, Malay, Filipino, Fijian and White. The central figure is Mrs. V.

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Table II

Malay - Filipino - Fijian - White (Fig. 10)

	Age	Eyes	Hair	Eyebrows	Eyelashes	Skin	L	B	C.I.	Ears
Mother [1]	52	4	black, closely curly	light brown	brown	5, more red	174	144	82.76 [2]	63×32 small lobe
Daughter	30	4	black, ± wavy	black	black	5-6 [3]	173	143	82.66	57×32.2 no lobe
Daughter	20	3	black, curly to frizzy	black	black	5-6 [3]	175	153	87.43	53.9×31.8 no lobe
Granddaughter V. 1	11	5	black, slightly wavy	black	black	near 6	172	136	79.07	54.9×34 very small lobe
Grandsons V. 2	7	3	black, curly	black	black	ca. 5 [4]	—	—	—	50.5×30 square lobe
V. 3	5	4	very dark brown, ± wavy	very dark brown	black	4-5 [4]	—	—	—	52.8×28.9 no lobe
V. 4	2	8 (hazel)	very fair, curly	fair	black	near white [5]	—	—	—	—
Granddaughter V. 5	5 mo.	4	light brown	light brown	light brown	near white [6]	—	—	—	—

[1] No. III. 3 in Text-figure 5.
[2] Nasal root slightly depressed, nasal tip ± overhanging. Figure 10.
[3] Arms ≠ 5, face darker than ≠ 6.
[4] Nasal root not depressed. Fig. 10.
[5] Nasal root deeply depressed. Fig. 10.
[6] Skin of face slightly lighter than brother, legs slightly darker.

Table III

Papuan × White, F1 (Figs. 11, 12, 13)

	Age	Eyes	Hair	Eyebrows	Eyelashes	Skin Remarks
Father	65	hazel	grey, ± wavy	—	—	white
1st wife	—	—	black, woolly	—	—	—
Son	9	medium brown	very light brown, very curly	—	—	very light brown [1], nasal root slightly depressed, nostrils ± broad, few freckles.
Daughter	6	slightly darker than brother	blond, wavy to curly	very light brown	darker	slightly brownish where tanned [2].
2nd wife	—	—	—	Nose ½ depressed, lips thick, ears small.		
Son	7	medium brown	dark blond, close curly	—	—	near white [1]
Son	4½	medium brown	dark blond, curly to wavy	—	—	near white [1]
3rd wife	—	—	—	—	—	—
Son	8	medium brown	light brown, near woolly	light brown	brown	very light brown. Lips ± thick, nose ½ depressed, narrow.
Son	5	medium brown	close curly, near blond	—	—	pale brownish. Lips slightly thick, nose 3/4 depressed, not broad.

[1] Body skin practically white.
[2] No freckles. Ears small, with lobe.

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(III. 3 in the pedigree). Her father (II. 1) was the son of a white man and a Malay woman, i.e. F_1, Malay × White. Her mother was similarly an F_1 Fijian × White. She thus combined two parts of White with one of Malayan and one of Fijian. As shown in Table II, her eyes were dark, hair black and closely curly, skin near # 5 in the Gates colour scale, but more red (see Fig. 10, which shows the family in three generations). She and her two daughters were all brachycephalic. The daughters, especially the elder, were a shade lighter than the mother in skin colour. The hair of the elder daughter was wavy whereas that of her younger sister was curly to frizzy, the frizzy quality presumably from the Fijian ancestor. The nasal root in all three was slightly or not at all depressed. This condition occurs to some extent in Europeans. The nose in all three was not only high but rather narrow. The overhanging nasal tip of the mother is frequent in Papuans and might have been derived from the Fijian grandmother.

The elder daughter (IV. 2 in Text-fig. 5) married a man whose father was a Filipino and his mother of mixed aboriginal descent. Of their three children, aged 11, 7, and 5 (Table II), the two boys are in Fig. 10 (front right). All three had dark eyes and black hair, except the younger boy, whose hair was very dark brown. The hair was slightly wavy in the girl, curly in the elder boy and ± wavy in the younger. Eyebrows and eyelashes were black or (in one case) very dark brown. Skin colour showed little variation, from 6-4 in the colour chart.

In careful observations of skin colour the face often differs somewhat from the arms, being generally but not always darker. Szabo (1954) has shown that in Caucasians the melanocytes of pigment cells (in which the melanin granules appear) differ in frequency in different parts of the body. By counting these cells under the microscope he found about 1000 per square millimetre on the thigh and arms, but 2000-4000 per square millimetre in the skin of the ears, cheeks, forehead and neck. This, as well as differences in exposure to sunlight, helps to account for the variations frequently seen in skin colour in different parts of the same individual. Such a case is recorded in Table II, but the difference may be more marked.

The younger daughter (IV. 5, Table II) married a man whose father was half White and mother of mixed Malay descent. The two young children (left front in Fig. 10) contrast strongly with the sister's children. The boy has hazel eyes, very fair, curly hair, fair eyebrows and black eyelashes. His skin is brunet white, the nasal root deeply depressed. The younger sister (5 months only) has dark brown eyes, light brown hair and eyebrows. The skin colour of the face is slightly lighter and of the legs slightly darker than the brother. This family, while showing marked segregation in various features, is of too racially mixed origin for more than an incomplete analysis in terms of genes.

Table III contains the descriptions of three families with Papuan mothers and a White father. These are of special interest for comparison with Australian aborigines × White (Gates 1960) because of the marked similarity in the two crosses as regards skin colour and hair colour. This appears to be the first time this F_1 cross has been studied in detail.

An Englishman now about 65, living near Mount Hagen, New Guinea, took three native Papuan wives and had eight children by them. The two oldest sons were at school in Queensland. The remaining six, with their mothers, are described here. The father had hazel eyes (blue with a ring of yellow around the pupil) and grey (formerly fair) hair which was more or less wavy. He was tall and of fair complexion. The three wives lived in separate native houses, and the children slept in their father's house on cots arranged in dormitory style.

The first wife (Fig. 11) was exceptionally large and stout. She came from near Goroka and had letters tattooed on her breast as well as a pattern on the face. Her hair was black and woolly, features Papuan. In the Papuan population one sees not infrequently men with very broad nostrils, heavy brow ridges and sunken orbits (Fig. 12), showing that the genes for these features in the Australian aborigines are also found in many Papuans. The woolly hair is the main feature distinguishing this Papuan, from Goroka in the interior of New Guinea, from an Australian. The boy from this mother (Fig. 11) has medium brown eyes and very light brown (blond) very curly hair (Table III). His body skin is practically white, his face very light brown with a few freckles. The root of the nose is only slightly depressed and the nostrils are somewhat broad. Measuring instruments were not available when these observations were made. The boy's sister had slightly darker brown eyes with blond hair, wavy to curly, very light brown eyebrows and darker eyelashes. Her skin colour was slightly brownish where tanned, but it was essentially white with no freckles.

The second wife, with her two sons, is shown in Fig. 13. She also came from near Goroka. Her lips are thick but not everted [1], her nasal root half-depressed and the orbits somewhat sunken. She is wearing strings of beads over her breast. Her two sons (Table III) both have medium brown eyes and dark blond hair, a little more closely curly in the elder boy. There are no essential differences between these brothers. Their untanned skin is practically white, and even their faces are light.

The third wife (Fig. 14) also had two sons. She is the youngest, and also came from the Goroka district of central New Guinea. She is tattooed, her hair is black, woolly and cut short. In New Guinea it is the men who do not cut their hair. They frequently allow it to grow into great mops, but not content with that they add a heavy wig covered with tapa cloth, and often with bird's feather's or croton leaves attached (Fig. 15). This third wife had rather broad nostrils with a slight overhang (a Papuan character [2] not found in the Australians). Her nasal root was 3/4 depressed, her lips rather thick but not everted, her ears with a big lobe. Her two boys have medium brown eyes, but their hair is different. The elder boy has light brown, nearly woolly hair, whilst the younger one's is closely curly and near blond (Fig. 14).

[1] Lips which are thick throughout and somewhat pouting but not everted are frequent both in Papuans and Australian aborigines.

[2] This nasal overhang is frequently called Semitic or jewish, but three are differences from the Semite nose, and this is evidently an independent (parallel) development. The condition is accentuated by piercing the nasal septum and inserting a piece of wood or bone.

The eyebrows were light brown, the eyelashes brown. The skin colour of the elder boy was very light brown, that of the younger pale brownish. The lips were somewhat thickened, especially in the eldest boy, the nasal root ± depressed and the nose rather narrow. Some of these features may become more conspicuous as the boys grow up.

These six children of the same father show from each mother a lighter and a somewhat darker child. A remarkable feature is the nearly white skin colour in all. In an extensive study of the skin colour in three generations of Australian × White (Gates 1960), it was found that the aborigines have only one main gene for skin colour, with a minor one producing brunet-white skin; much of their skin pigmentation is due to tanning. In the cross, Papuan × White, only the F_1 is yet available (and a back-cross described below) in the interior of New Guinea where white contacts only began in the 1930's. At Port Moresby where racial contacts began much earlier, three generations of hybrids are available but their history is more difficult to trace.

It is evident from the above studies that the Papuan skin contains probably even less melanin than the aborigines. From these results it is necessary to conclude that a single main gene for melanin in the skin is present in the Papuan race. This is an additional genetic similarity between Papuans and Aborigines.

As regards hair colour, the results are even more surprising. Papuan hair always appears black or nearly so, yet in these crosses of pure Papuans with a fair-haired European, three of the children have fair hair, the other three only a little darker. The explanation of this awaits further evidence. Of course it may darken later. Hair form in these children is understandable, ranging from near the woolly hair of the mother to curly and wavy. Two or three genes with cumulative effects are sufficient for this series.

The first family in Table IV includes the back-cross of the F_1 (Papuan × White) to the White race. This family lived near Port Moresby where there has been much longer contact between the races. The mother in this case (Fig. 16) had a full Papuan mother and a Scotch father. Her eyes were # 6 (light brown), her hair black, abundant and with a fine crinkle. Her Scots father presumably had black hair. Her eyebrows and eyelashes were black, her skin about # 5 (pale brown or yellow) in the colour chart. She had a small and narrow nose, half-depressed at the root. Her husband (Fig. 17) was a White Australian with very blue eyes and light coloured, wavy hair. His head was pentagonoid in top view. In this back-cross to the White race the daughter (6 years old) had blue eyes, medium brown, wavy hair, with fair eyebrows and dark eyelashes. Her skin was white. The son (Fig. 17) also had blue eyes like the father, with medium brown hair (no kink), fair eyebrows and dark eyelashes, and a white skin. The daughter, 15 months old, had hazel eyes, light brown hair, with light (fair) eyebrows, light brown lashes and white skin.

It will be seen from the Table that both parents have a high C.I. (79.8 and 77.1). The two children have a closely similar C.I. but the baby is brachycephalic. With growth, its index may be reduced to that of the parents. It may be noted that in top view the father's head and that of two children were pentagonoid, the third only

slightly so. Much more evidence is required regarding the inheritance of top-view head shapes. From the evidence of these two families it appears that a single gene for melanin in the skin may be present in the Papuan race.

The last family in Table IV was studied at Madang, on the north coast of New Guinea. Both parents are F_1 Papuan ♀ × Chinese ♂, the Papuan mothers both coming from Madang where there is considerable variation of type. Their children are F_2. The parents have the same intermediate skin colour, but his hair is more curly, hers more wavy (Fig. 18). The father has the top eyefold and the mother both eyefolds, derived in each case from the Chinese father. The maternal Chinese came from Canton, where not all Chinese are brachycephalic. This may account for the mesocephaly of the F_1 mother. The brow ridges and sunken orbits of the F_1 father must have been derived from his Papuan (Melanesian) mother. He has only the top eyefold while his wife has also the epicanthus, Both have Papuan noses with a broad, overhanging tip, and both (especially the father) have sunken orbits. The two eldest children have the same skin colour as the parents, the two youngest being a little lighter. The children all have very dark eyes like the parents. The eldest son (between the parents in Fig. 18) has dark brown, nearly straight hair and light brown eyebrows. The next child (on the left in Fig. 18) has medium brown, very curly hair with light brown eyebrows. The second son (standing in front) has medium brown, ± wavy hair and light eyebrows while the baby daughter has medium brown, nearly straight hair.

Segregation between these sibs is practically confined to hair colour, hair form and head shape, except that the two youngest children have a shade lighter skin colour. In C.I. there is also genetic segregation, the eldest boy being like his mother, the next two children (girl and boy) like their father. The baby was considered too young to measure. Thus in the F_1 we have additive effects of the Papuan and Chinese races. In the F_2 most of these are retained, but segregation has occurred in the characters already mentioned.

Observations of hair form in Papuans on the southern coast of New Guinea at Port Moresby and in Melanesians of the highland interior, especially at Mount Hagen and Goroka, lead to the conclusion that Melanesian hair is fundamentally the same as the woolly hair of the African Negro. This identity is most apparent in boys, before the hair has grown long. In Melanesian men the hair is allowed to grow indefinitely, being combed out into mops of long, crinkled, more or less parallel hairs. In Africa it is the women who often train their woolly (interwoven) hair into various fantastic patterns. Whether woolly hair originated independently in South Asia and in Africa through two independent but parallel mutations, or whether a single origin in one continent was followed by spread through migration to the other continent, is a question which is now difficult to decide. But if there was a single origin it seems more likely that it was in the East, because skeletons of Negro race appear so late in African pre-history.

Table V records the physical characters of John Douglas Guise (Figures 19, 20) and his family. His ancestry is shown in Text-figure 6, where he is No. III. 2. He is

Table IV

	Age	Eyes	Hair	Eyebrows	Eyelashes	Skin	L	B	C.I.	Ears
Father	35	14 (blue)	Light, wavy	—	—	white [2]	183	146	79.78 [1]	Fig. 17
Mother [5]	30	6	black, long, ± crinkly	black	black	ca. 5	179	138	77.09	60.8×33 Fig. 16 very small lobe
Daughter	6	14 (blue)	medium brown, wavy	very fair	dark	white [4]	170	132	77.65 [3]	50.4×32.3 good lobe. Fig. 17.
Son	5	14 (blue)	med. brown	fair	dark	white	178	137	76.97 [1]	57.2 32.7 lobe Fig. 17.
Daughter	15 mos.	... hazel	light brown.	light	light brown	white	154	125	81.17 [1]	46.1×31. small lobe. Fig. 16.
Madang Family										
Father [6]	23	3	black, closely curly	black	—	4, more red	192	154	80.25	64.7×38 lobe. Fig. 18
Mother [7]	21	3	black, wavy	black	—	4, more red	176	134	76.14	52.7×24.8 no lobe
Son	5	2	dark brown near straight	light brown	—	4, more red	173	133	76.88	51.9×28.4 small lobe
Daughter	3	2	medium brown very curly	light brown	—	4, more red	167	134	80.24	46.4×31.3 no lobe
Son	2	3	med. brown ± wavy	light	—	lighter than sibs	151	124	82.12	52×31.1 no lobe, attached
Daughter	1	2	med. brown, near straight	light	—	lighter than sibs	—	—	—	—

[1] Pentagonoid in top view.
[2] Formerly freckles on arms, now only on face.
[3] Strong freckles.
[4] Slightly pentagonoid.
[5] Her mother Papuan, father Scotch. Nose ½-depressed, naorrw.
[6] Top eyefold, heavy brow ridges, sunken orbits, nasal root ± depressed, nostrils very wide and overhung, mouth small, lips thin.
[7] Both eyefolds, orbits sunken, nasal root ± depr., nostrils wider overhang, lips slightly thick.

Table V

	Age	Eyes	Hair	Skin	L	B	C.I.	Ears	Remarks
John Guise	44	4	black, crinkly	near 5	192	145	75.52	60.7×32.9 small lobe	Pentagonoid
Wife	30	4	black, crinkled and curly	near 4	176	135	76.70	67.1×32.2 no lobe	—
Daughter	7	4	black, wavy	near 4	168	130	77.38	53×33.1 no lobe	not pentagonoid
Daughter	5	—	dark brown, wavy	near 4	—	—	—	50×32 small lobe	—
Baby	—	—	—	white	—	—	—	—	—

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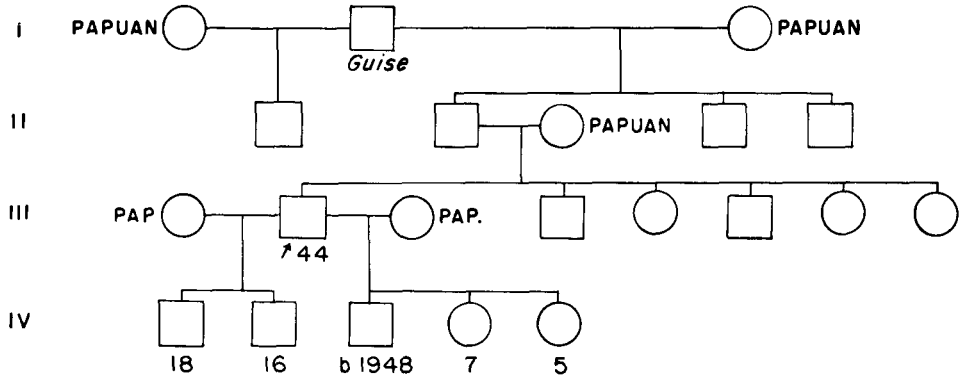
an official in the Native Affairs Department at Port Moresby and claims descent from the Duc de Guise, a French nobleman who later migrated to England. Mr. Guise is descended from an illegitimate son of the English family. The tomb of his greatgrandfather, Reginald Edward Guise, is stated to be in the cemetery of St. John the Baptist in Canberra. He is said to be the father or uncle of the Englishman (I. 2



Textfigure 6

in Text fig. 6) who first married a Papuan woman. Mr. Guise (Figs. 19, 20), No. III. 2 in Text fig. 6, is a grandson of this Englishman with French ancestry and name. His descent is otherwise pure Papuan. As will be seen from the photographs, the heavy brow ridges and depressed nasal root are Papuan, as is the interwoven, crinkly, black hair. The only features which show European influence are the facial shape and the nasal bridge. He married a purely Papuan woman. The anthropological characters of the family are shown in Table IV. It need only be remarked that the hair of the two daughters (ages 7 and 5) is wavy rather than crinkled, and the baby had a white skin which will no doubt darken later. The same is true of the babies (Gates 1960) among the Australian aborigines.

This family history shows how little effect a single cross with another race produces in the native type. The foreign features are submerged in the sea into which a single set of alien genes has been dropped. Yet these genes will persist and recombine, producing small, mostly undetectable aberrations from the racial type. Probably some of the " variability " in all races is derived from such sporadic race crossing.

Discussion

This somewhat miscellaneous collection of racial hybrids from Darwin (Australia), Mount Hagen and Port Moresby (New Guinea), has been selected because each family is of genetical significance as showing how particular characters are transmitted in crosses. The collection of massed statistics of racial crosses is of little analytical value either to genetics or anthropology, although interesting comparisons of variability in racial characters can be made in this way (e.g. Trevor 1958). It appears that the only way in which a real analysis of racial characters can be made is by a careful and intensive study of individual pedigrees where the original ancestors belonged to different races. The method itself is simple enough, and it is very surprising that scarcely any geneticist or anthropologist has attempted it. Ideally, all members of each family in three generations should be studied and compared, but in practise this is rarely possible. It is evident that to be successful in this field one must have had not merely book knowledge of genetics but practical experience in the field of plant or animal experiment. If one is to apply genetical methods to the study of race crossing one must also be willing to view racial characters from a new angle. One must endeavor to learn how the multiple genes for each racial character cumulate and interact with the genes determining other characters.

This paper gives a preliminary analysis of several racial crosses which have not previously been studied genetically. In some of these families, three or even four races are involved in the ancestry. The racial characters all segregate, but since they are based on multiple genes the superficial result appears as blended inheritance for some characters. Much more extensive studies are required, involving all the races of mankind which are sufficiently in contact to produce hybrids. Both genetical and anthropological knowledge and experience are required. The almost complete failure of such analytical studies to be made shows that for success other qualities and attainments are also necessary, in addition to those already mentioned. The point of view must be primarily genetical, and the approach to hybrid individuals must be such as to enlist their cooperation and support. This can be done by showing an individual interest in them, and leading them to see that they are contributing to a fuller knowledge of human types. Some may wish to have some basis for predictions concerning what their own offspring may be like. But conditions vary greatly from family to family, and each may have to be approached in a different way in order to obtain their full cooperation, in supplying information as well as submitting to measurements. Needless to say, all information requires careful checking wherever possible. For instance, illegitimacy may be determined from certain characters of a child, and afterwards confirmed by learning the family history from other sources. But such cases are much fewer than might be suspected.

When possible, it is advantageous to use the blood groups as a check. Such tests were not possible in this work, but if the blood groups of whole families in two or three generations could be determined in comparison with the physical characters, much could be learned. Hitherto, blood grouping has been done mainly *en masse*,

selecting only one or two members from each family so as not to distort the frequency ratios through inheritance of the genes represented. This gives certain useful pictures of race relationships; but there are cases, as in the Ainu and the British Columbia coastal Indians where the blood group picture is clearly at variance with that derived from the physical characters. The Kwakiutl and other coastal Indians have very Mongoloid physical characters, more so than other Indian tribes, yet they do not have the B blood group, which is high in Mongolians (Gates 1956, p. 246). The other horn of this dilemma is that the Ainu, who have no physical Mongolian character, are yet high in the B blood group.

The various blood group series are now regarded as markers for 9 of the 23 chromosomes in man. Attempts to find linkages with the many physical characters in man have thus far been singularly unsuccessful (Mohr 1953, Gates 1955). Without inquiring into the reasons for this, or citing the few known cases, it may be pointed out that a field hitherto almost unexplored consists in the recording, in families of known mixed racial descent, of both the serological genes and those for racial characters. This seems the most promising way of bringing the blood group genes and those for physical racial characters into individual relation with each other.

In a recent memoir, Manuila (1957) has made a correlated study of the ABO blood in groups Rumania and the anthropological characters of the many ethnic groups in the ten provinces of that country, which is a mosaic of ethnic types. Although all the data are *en masse* for particular areas, they are combined with historical data and many significant results regarding local racial relationships are thus obtained. The Dinaric race is regarded as occupying a zone in Eastern Europe, from the Baltic to the Balkan countries, in which the B blood group ranges from 10-15%, but the origin of this race is still obscure.

Acknowledgements

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Other studies in New Guinea will be published later. In Port Moresby Mr. J. Keith McCarthy, Director of Native Affairs, gave abundant information and advice about the interior, which is gratefully acknowledged. At mount Hagen my mentor was Mr. Richard Ian Skinner, District Commissioner for this area in the highlands of New Guinea, who unobtrusively arranged our coming and going as well as hospi-

tality. In Madang we were indebted to Mr. Ronald Galloway, Acting District Commissioner, for various arrangements. Last but not least, my wife, who took the colour photographs which illustrate this paper, has also assisted in its preparation.

Summary

In continuation of the series of studies of racial crosses, this paper gives a genetical account of various race hybrids, in which Australian aborigines or Papuans are involved with Chinese, Malayans or Filipinos. Several families are traced through four or five generations, and some involve three or (in one case) four different races. Most of these racial combinations have not been studied previously.

The racial characters recorded in Tables include colour of eyes, hair, eyebrows, eyelashes and skin, form of hair and measurements of head and of ears. In addition various observations of brow ridges, orbits, eyefolds, nose, lips and mouth were made. The Mongolian brachycephaly is strongly inherited from male Chinese ancestors; also the eyefolds, especially the top fold, which is more or less independent of the epicanthic fold. In Malay crosses the face and head are often very narrow. Marked segregation in sibs can occur in head form (cephalic index), hair colour, hair form, skin colour and other features. It has already been shown that in the F_1 of aborigines $\times$ White the skin is near white. The same is true of Papuan $\times$ White, and in addition the child's hair is flaxen or very light brown although the Papuans appear to have always black or near-black hair.

Incidentally, it was also observed that the Papuans not infrequently have marked brow ridges, depressed nasal root and sunken orbits like the Australian aborigines, indicating common elements in the ancestry of these two races.

The Papuan nose, commonly with an overhanging tip, differs in some respects from the Semitic nose, and appears to be an independent (parallel) development.

All contrasted human racial characters, such as hair form and colour, head shape, brow ridges, nasal root depression, size of ear and of mouth appear to depend on a *small* number of cumulative genes, generally without dominance. In how far these are alleles or based on genes at independent loci can only be determined by further investigations.

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RIASSUNTO

Continuando la serie degli studi sugli incroci raziali, questo lavoro fa una relazione genetica degli ibridi di varie razze, in cui gli aborigeni Australiani o Papuani sono uniti a Caucasici, Cinesi, Malesi o Filippini. Molte famiglie sono descritte attraverso quattro o cinque generazioni ed alcune comprendono tre o (in un caso) quattro razze diverse. Molte di queste combinazioni raziali non sono state studiate precedentemente.

I caratteri raziali riportati nelle Tabelle comprendono il colore di: occhi, capelli, ciglia, sopracciglia e pelle; la forma dei capelli e le misurazioni del capo e delle orecchie. Furono fatte inoltre svariate osservazioni sulle rughe, sulle orbite, sulle pliche degli occhi, sul naso, sulle labbra e sulla bocca. La brachicefalia dei Mongoli è in gran parte ereditata da antenati *cinesi di sesso maschile; così pure* le pliche degli occhi, soprattutto la plica superiore che è più o meno indipendente dall'epicanto. Negli incroci Malesi la faccia ed il capo sono spesso molto stretti. Nelle fratrie può verificarsi una marcata segregazione per la forma del capo (indice cefalico), il colore e la forma dei capelli, il colore della pelle ed altri tratti. È già stato dimostrato che nella F_1 di aborigeno × Bianco la pelle è quasi bianca. Lo stesso vale nel caso di papuano × Bianco ed inoltre i capelli del bambino sono biondi o di un castano molto chiaro, benchè i Papuani abbiano sempre capelli neri, o quasi neri.

È stato anche osservato, incidentalmente, che i Papuani presentano con una certa frequenza rughe marcate, radice nasale depressa ed orbite incavate come gli aborigeni Australiani, il che sta ad indicare dei comuni elementi ancestrali nelle due razze.

Il naso Papuano, la cui punta tende generalmente in basso, differisce in alcuni caratteri dal naso semitico e sembra essere uno sviluppo indipendente (parallelo).

Tutti i caratteri raziali umani contrastanti, quali la forma ed il colore dei capelli, la forma del capo, le rughe, la depressione della radice nasale, la grandezza delle orecchie e della bocca, sembrano essere dovuti ad un *basso* numero di geni cumulativi, generalmente non-dominanti. Solo in ulteriori studi potrà essere stabilito quanto essi siano alleli, o basati su geni situati in loci indipendenti.

RÉSUMÉ

En continuant la série des études sur les croisements raciaux, voici une relation génétique des ibrides de diverses races, où les aborigènes Australiens ou Papouas sont croisés aux Caucasiens, aux Malais, aux Chinois ou aux Philippins. Beaucoup de familles sont suivies à travers quatre ou cinq générations et certaines comprennent trois ou (dans un cas) quatre races différentes. La plupart de ces combinations raciales n'ont pas été considérées jusqu'à maintenant.

Les caractères raciaux reportés dans les Tables comprennent la couleur des yeux, des cheveux, des cils, des surcils et de la peau; la forme des cheveux et les mesurations de la tête et des oreilles. Des observations ont été faites, en plus, sur les rides, les orbites et les plis des yeux, ainsi que sur le nez, les lèvres et la bouche. La brachycéphalie des Mongoles est héritée, en bonne partie, des ancêtres Chinois mâles, et aussi les plis des yeux, surtout le pli supérieur qui est plus ou moins indépendent de l'épicante. Dans les croisements Malais le visage et la tête sont souvent très étroits. Il peut se vérifier chez les siblings une remarquable segrégation pour la forme de la tête (index céphalique), la couleur et la forme des cheveux, la couleur de la peau et d'autres caractères. Il a déjà démontré que dans la F_1 de aborigène × Blanc la peau est presque

blanche. Il en est de même dans le cas de Papouas × Blanc et, en plus, les cheveux de l'enfant sont blonds ou d'un chatain très clair, quoique les Papouas aient toujours des cheveux noirs ou presque noirs.

Il a aussi été remarqué, presque accidentalement, que les Papouas présentent assez fréquemment des rides profondes et la racine nasale et les orbites enfoncées comme les aborigènes Australiens, ce qui ferait penser à des éléments ancestraux communs dans les deux races.

Le nez Papouas, dont la pointe tend généralement vers le bas, diffère pour certains caractères du nez sémitique et paraît être un développement indépendant (parallèle).

Tous les caractères raciaux humains contrastants, tels que la forme et la couleur des cheveux, la forme de la tête, les plis, la dépression de la racine nasale, la grandeur des oreilles et de la bouche semblent être dûs à un *petit* nombre de gènes cumulatifs non-dominants. Ce ne sera que dans de prochaines études que l'on pourra établir jusqu'à quel point soient-ils allèles, ou basés sur des gènes situés dans des locus indépendants.

ZUSAMMENFASSUNG

In Fortsetzung der Serie von den Rassenkreuzungen Untersuchungen, macht der Verfasser eine genetische Beschreibung über die hybriden von vielen Rassen (Australianern und Papuasern Eingeborenen mit Kaukasern, Chinesen, Malesen und Philippinen). In vielen Familien geht die Beschreibung vier/fünf Generationen durch und in einigen gibt es drei oder (in einem Fall) vier verschiedene Rassen. Viele dieser Rassenkreuzungen sind bisher nicht untersucht worden.

Die in den Tabellen beschriebene Rassenmerkmale enthalten die Farbe von: Augen, Haar, Augenbrauen und Haut; die Form des Haares und die Masse des Kopfes und der Ohren. Die Falten, die Augenhöhlen, die Augenfalten, die Nase, die Lippen, den Mund sind auch beschrieben worden. Die Brachykephalie von den Mongolen ist von männlichen Chinesischen Ahnen am meistens geerbt und auch die Augenfalten, besonders die höchste Falte die, mehr oder weniger unabhängig com Epikanthis ist. In Malesischen Kreuzungen sind das Kopf und das Gesicht oft sehr eng. Eine starke Absonderung in den « siblings » kann in der Form des Kopfes, in der Farbe und der Forme des Haares, in der Farbe der Haut und in anderen Merkmalen begegnet werden. Es war schon beweist dass die Haut in der F_1 von Eingeborenen × Weiss fast weiss ist. Im Fall von Papuaser × Weiss ist es das gleich und, ausserdem, ist das Haar des Kinders blond oder fast blond, obwohl die Papuasern ein schwarzes oder fast schwarzes Haar immer haben.

Nebenbei hat man auch bemerkt dass die Papuasern starke Falten, vertiefte Nasalwurzel und ausgehöhlte Augenhöhlen wie die Australianern Eingeborenen haben; darum denkt man dass die zwei Rassen einige gemeinschaftlichen Ahnen haben.

Die gewöhnlich vorspringende Papuasische Nase ist etwas verschieden von der semitischen Nase und scheint eine unabhängige (parallele) Entwicklung zu sein.

Alle menschlichen verschiedene Rassenmerkmale, wie die Form und die Farbe des Haares, die Form des Kopfes, die Falten, die Vertiefung der Nasalwurzel, die Grösse des Ohres und des Mundes sind von einer kleinen Nummer von gewöhnlich non-dominanten Genen wahrscheinlich abhängig. Nur durch andere Untersuchungen kann man wissen bis wo sind sie allele, oder auf Genen in unabhängigen loci gegründet.

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