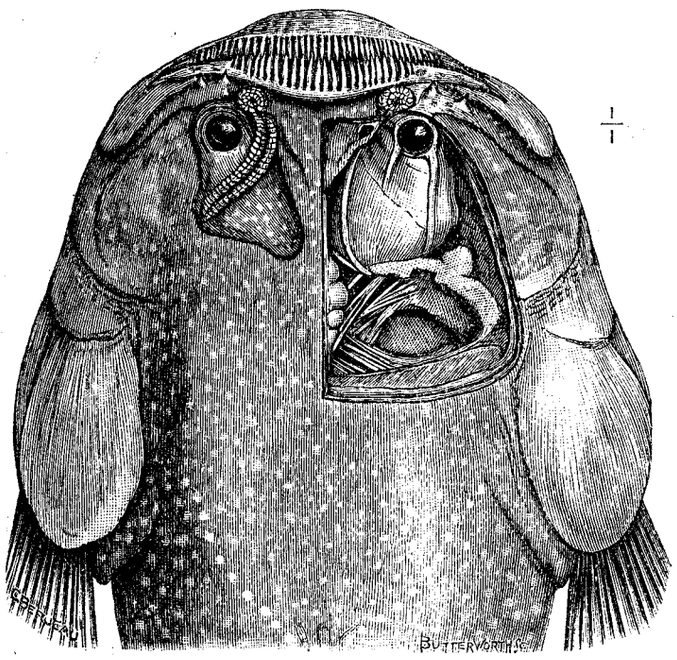
occupied Luderitzbucht (now Bothaland) in 1914, the dust of that remarkable sandy, diamond-strewn desert, blown by the prevailing wind, proved so troublesome that the eyes of the transport mules required protection by goggles.

In lizards a long slender tendon fixed to the roof of the orbit passes in the usual fashion to the lower corner of the nictitating membrane. (Fig. 5.) At the level of the optic nerve this tendon threads a sling in the bursalis muscle, which muscle represents the retractor bulbi of mammals; it

FIG. 6.



Orbit of the Stargazer, dissected to show the electric muscle.

arises from the back of the orbit, runs parallel with the optic nerve, and is inserted into the sclerotic coat of the eye. When the bursalis contracts it acts on the tendon and draws the nictitating membrane across the eye. It is a rare arrangement for a muscle to be inserted into the tendon of another muscle. There is an example in man in his foot: the muscle is called accessorius.

The pyramidalis is curiously modified. In crocodiles it is relatively big and muscular throughout. In birds it is one-fourth muscle and three-fourths tendon. In lizards the pyramidalis, entirely represented by a tendon, is activated by the retractor (bursalis) muscle. In sheep and many mammals the retractor works the nictitating membrane indirectly by acting on the globe. In man it is represented by a fibrous funnel that serves as the wall of a lymph-channel. In a fish, *Astroscopus*, some of the orbital muscles become electric organs.

ELECTRIC MUSCLES IN THE ORBIT.

The contractile substance of muscles is structureless and enclosed in a husk, called the sarcolemma. The jelly in each muscle husk receives the terminal of a motor nerve and serves as a means for the discharge of the force developed in nerve cells. Embryologists have discovered that in spite of the differences in structure of muscle cells and nerve cells they have the same origin but nerve cells are modified to originate impulses which are conducted by the nerves and discharged by the muscles.

Organs are not strictly adapted to one purpose; they have a main function and subsidiary functions. Changes may gradually affect an organ and a secondary function become dominant. This happens to a surprising degree in some fishes, for definite tracts of muscle are so modified that the electric property predominates. In such fishes the electrical muscles, like ordinary muscles, are under voluntary control and become exhausted by use.

Electric muscles exist in several fishes—torpedo, skate, electric eel (which is not an eel), the stargazer, and the mormyr, a fish of peculiar shape living in the Nile. It was venerated by the ancient Egyptians and depicted on monuments. The proof that electric organs are modified muscles is furnished by the skate. In this fish the electric muscles lie in the tail. When the skate is young and like a big tadpole its electric organs are muscles, and Ewart succeeded in tracing the transformation of the muscle cells into electric cells.

The eyes of the stargazer are on the top of its head and the mouth is in such a position that, without knowledge of the cunning contrivance in the orbits, it would not be easy to understand how this fish secures food. Each orbit is roofed with a patch of soft skin, and this covers an electric organ. (Fig. 6.) The fish lies in the sand, and small fishes passing over it, paralysed by an electric shock, tumble into its open mouth. In an example dissected by Dahlgren the stomach contained a number of small swiftly swimming fishes, such as young herring and mackerel. The electric organ lies in the midst of the orbital muscles, and receives a large branch from the third nerve and branches from the trigeminus (Sylvester).

Progress in the acquisition of reliable knowledge concerning life depends on accurate instruments. For example, the minute structure of muscle was unknown before the invention of the microscope, and the elucidation of the physics of muscular contraction required the assistance of delicate measuring apparatus. An accurate knowledge of animal heat was obtained by the use of a reliable and delicate heat measurer, the thermometer, an instrument which proved that animals have within themselves a source of heat. To-day clinical thermometers are as common in nurseries as the toy called Noah's Ark. John Hunter, when he laid by experiments controlled by Ramsden's reliable thermometers, the foundations of modern knowledge on this important matter, never imagined that muscles are the chief source of animal heat.

The study of the muscles concerned in the movements of the third eyelid may cause you to reflect deeply on the absorbing subject of the physiology of muscles. Such a study may lead some of you to make discoveries in physics and neurology that will one day make the world gape with astonishment.

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SEROLOGICAL DIFFERENCES BETWEEN THE BLOOD OF DIFFERENT RACES.

THE RESULT OF RESEARCHES ON THE MACEDONIAN FRONT.*

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Race Problems and Researches in Immunisation.

IT is a well-known fact that it is possible to produce antibodies by injecting an animal of one species with the red blood corpuscles of an animal of a different species. These antibodies, which we call hetero-antibodies are capable of reacting with the erythrocytes of all representatives of the species used for immunising. A rabbit immunised with the blood of a man of any race will produce agglutinins or hæmolysins which can influence to a greater or lesser degree the blood corpuscles of men of any race. The hetero-antibodies are thus specific for a species and cannot bring us nearer to the solution of the race problem.

But, as Ehrlich showed in goats and von Dungern and Hirschfeld[1] in dogs, we do possess a means of finding serological differences within a species. This is effected by immunisation *in the species*. The reason for this can be explained in a few words. Those antigen properties which are common to the giver and receiver of blood cannot give rise to any antibodies, since they are not felt as foreign by the immunised animal. The

* Paper read before the Salonika Medical Society, June 5th, 1918, and submitted to us for publication in September 1919.

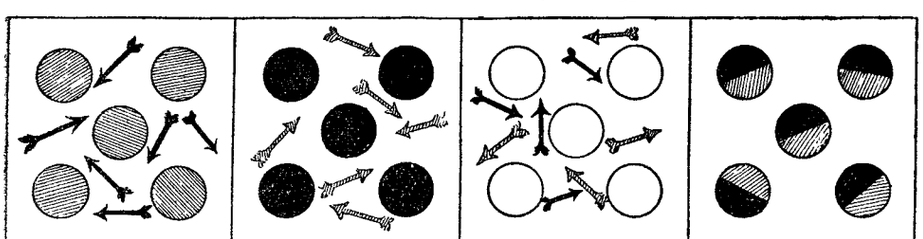
[1] Von Dungern: Münchener medizinische Wochenschrift, 1911. Von Dungern and Hirschfeld: Zeitschrift für Immunitätsforschungen, 1911, Comm. I., II., III.

antibodies produced within the species which we call iso-antibodies do not, therefore, act against the whole of the antigen properties of the species, but only against the differences between the blood of the animal which provides the blood for injection and that of the recipient. The iso-antibodies thus do not influence all representatives of the species, but only the blood used for injection and other kinds of blood similar to it. If we inject into dogs the blood of other dogs it is in many cases possible to produce antibodies. By means of these antibodies we have been able to show that there are in dogs two antigen types. These antigen types, which we recognise by means of the iso-antibodies, we may designate biochemical races.

It was, therefore, clear to us from the beginning that we could only attack the human race problem on serological lines if we could succeed in making use of antibodies of this kind, for the iso-antibodies alone are capable of selecting from the whole of the biochemical elements which serologically characterise human blood as such those elements that are characteristic of the blood of only a part of the human species.[2]

Such a differentiation of the human species is now possible by means of the iso-agglutinins first analysed by Landsteiner. If the serum and the blood corpuscles of different pairs of human beings are brought together agglutination sometimes occurs. Accurate analysis of the agglutinable properties of the blood and of the agglutinating properties of the serum showed that this phenomenon has nothing to do with disease. It depends on the following physiological facts. There are present in human blood two agglutinable properties, which, however, are not equally marked in all individuals. In the serum there is never present an agglutinin reacting with its own blood, but always an agglutinin which reacts with that property which is absent in that particular blood. As has often been pointed out in the literature of the subject, these properties are of great importance in blood transfusion, for a blood must never be injected which can be agglutinated by the recipient. Either of the two agglutinable properties may be present or both together, or both may be absent, and we can therefore distinguish four different combinations in man. In the literature of the subject we therefore most often find the statement that there are in the human species four different groups. But since we have, indeed, four groups but only two agglutinable properties, von Dungern and Hirschfeld[1] introduced another definition which is shown in the accompanying table. (Table I.) They

TABLE I.—*Landsteiner's Law of Iso-agglutinins.*



called the agglutinable property, which is common in Central Europe, A, the other, which is rare in Central Europe, B. In the figure the blood corpuscles possessing the A property are shown shaded, those with the B property are black. Landsteiner's rule lays down that there are always present in the serum agglutinins against the agglutinable property which is absent in the blood corpuscles of the same blood. If the individual has in the blood corpuscles the A property, he has in his serum agglutinin anti-B, and vice versa. These agglutinins are represented diagrammatically by arrows corresponding with the agglutinable property, the anti-A being shaded, the anti-B black. We see in the first square of the figure the shaded red blood corpuscles A surrounded by the black arrows anti-B, while in the second square are the black blood corpuscles B with the shaded anti-A agglutinins. In the third square we see the non-agglutinable red blood corpuscles which possess neither A nor B property, called by von Dungern and Hirschfeld the Group O. In accordance with Landsteiner's rule that in the blood there are always agglutinins against the qualities lacking in the corpuscles we have here both the shaded anti-A and the black anti-B arrows. Finally, in the fourth square are represented the red corpuscles, which have both A and B properties, and accordingly no agglutinins. Below our diagram we have given the classification used by English writers on the subject. The English Group I. corresponds to our A B, Group II. is our A, and Group III. our B. As against Mosse, we wish to point out that Group I. does not represent any special individuality, but merely, as can easily be proved by absorption experiments, the combination of the properties A and B. For the differentiation of the groups, therefore, we require not three, but only two sera, A and B.

Results of Experiments.

What biological significance, then, has this peculiar differentiation of the blood within the human species, and how are these marks of the biochemical race inherited? Von Dungern and Hirschfeld first undertook experiments on the inheritance of these characteristics in dogs, and found that the biochemical properties of the blood are sometimes inherited and sometimes disappear in the offspring. They established, further, that the anatomical and biochemical characteristics are inherited independently of one another. Young dogs which had the general structure and colour of the mother showed the agglutinable properties of the father and vice versa.

Researches on the inheritance of the bio-chemical group properties in man as differentiated by means of Landsteiner's iso-antibodies permitted von Dungern and Hirschfeld to come to an important conclusion as to the nature of these properties. We succeeded in showing that the A and B properties are generally inherited, but sometimes may disappear in the offspring. When the parents had A or B we found sometimes the Group O occurring in the children. On the other hand, we never found either A or B property in a child when it was absent in the parents. This observation will permit under certain circumstances of medico-legal decisions being made in order to find the real father of a child. If we find in a child either A or B property when it is absent in the mother it must be present in the real father.

The analysis of our numerical results proved that we can apply Mendel's law to the inheritance of the bio-chemical properties A and B. Since the A and B properties may disappear but never appear spontaneously, we can regard them according to Mendel's law as those properties which once present in the germ-plasm must also be outwardly visible. Mendel, as we know, named such a property or quality, which always gives the species its outward appearance, the dominant, while the absence of the property (which property may appear in children although absent in the parents) is considered as latent or recessive, and is set in contra-distinction to the dominant. If, for example, the dominant is *red* the Mendelian quality or property antagonistic to it—e.g., *white*—is described as *non-red*. If we introduce the Mendelian terminology we can in our cases speak of non-A and non-B. With certain premises, which are discussed in the second part of von Dungern and Hirschfeld's paper, the figures showing the frequency of occurrence of A and B in central Europe can be brought into harmony with Mendel's law, the properties A and B being recognised as dominant, the properties non-A and non-B (the combination of which gives Group O) as recessive. A and non-A thus may be regarded as Mendelian pairs and similarly B and non-B.

What are the laws, then, governing the relationships of A and B with each other. The calculation showed that they simply fit in with the calculation of probability according to which A and B can come together when they do not influence each other. When A, for instance, occurs in half of all cases and B in one-tenth, A B will be found together in about one-twentieth—i.e., in 5 per cent. Experience has shown that the occurrence of Group I. (our Group A B) approximates to this figure. If, therefore, Landsteiner's rule is regarded from the broad biological point of view it can be stated as follows: There are within the human species four properties of blood, A, non-A, B, and non-B.

[2] This only applies to non-absorbed sera.

A and non-A, B and non-B behave to each other according to Mendel's law, while A and B, non-A and non-B do not influence one another. Experience has shown that the inheritance of the biochemical blood properties in man is not influenced by sex and does not correspond with the inheritance of anatomical qualities (family resemblance, &c.), so that we have to do with an independent heredity. The agglutinable properties appear already in embryonic life; we have observed them in a six-months' fœtus. We have succeeded in finding these properties in the placental blood even when they were absent in the mother. The iso-agglutinins, however, do not appear until the second year of life. We can confirm Landsteiner's observation that these group-properties have nothing to do with disease. They appear also not to alter with time. We ourselves possess the same groups and agglutinins which we found in our blood eight years ago in spite of the fact that one of us has had typhoid and now suffers from chronic malaria. The experiments in heredity, also, point to the constancy of the biochemical properties of the blood. There exist, indeed, weakly agglutinable blood corpuscles and weakly agglutinating sera. An accidental coming together of these might simulate Group O where in reality A or B was present.

We have often examined hundreds of specimens of blood with 10 different sera and found mostly only quantitative differences between the different A and B sera for the agglutinin is seldom absent. Rarely there are to be found certain anti-A (Group B) sera which agglutinate the corpuscles of rather more individuals than other sera. The corresponding groups are distinguished by von Dungern and Hirschfeld as Large-A and Small-a. We have therefore always used several sera for the examination of a people or a race, and, on the other hand, always used the same set of sera for the examination of different races. We have never observed that malaria has any influence on the agglutinations. The clumping in the blood of anæmic patients has nothing to do with the agglutinations, as one of us has succeeded in proving.[3] The red blood corpuscles always sink in their own plasma as soon as their number is so small that they cannot support each other. The rate of sinking thus runs parallel with the anæmia. It seemed, therefore, that it would be of interest to make use of the properties of blood, as defined by Landsteiner's rule, to form an anthropological criterion for the discovery of hitherto unknown and anatomically invisible relationships between different races. Through the accident of the war we happened to come to a part of the globe where more than elsewhere various races and peoples are brought together, so that the problems we are discussing, which otherwise would have necessitated long years of travel, could be brought in a relatively short time nearer to solution.

Technique.

The technique is as follows. We add a few drops of blood from the ball of the finger to a mixture of sodium chloride and sodium citrate solution (normal saline 9 parts, 2·5 per cent., Na citrate 1 part). A drop of the blood mixture is brought in contact in a small test-tube with a drop each of the A and B sera, of which the activity and specificity have always been established by a control experiment. The result was never read off in less than half an hour—a point of great importance, as particularly Group B is but slowly agglutinated. We used only Serbians as providers of serum. For each race several sera are used, but the same set of sera for all races. Our material consists for the most part of soldiers from various districts. This is to be regarded as a very favourable circumstance, since they are mostly unrelated to each other, so that the possibility that the frequency of a group might depend on family relationship is excluded. The refugees, as our statistics for the Jewish race particularly show, give evidence of great individual differences in the first, second, and other hundreds examined, so that the results must be confirmed by tests on more extensive material. The exact statistics with regard to the different tribes, provinces, anatomical structure, &c., will appear in an anthropological journal. We examined 500–1000 persons of each race. For the Germans we quote from memory the results of von Dungern and Hirschfeld as the statistical table for these is unfortunately not to hand. For the Austrians we use the Vienna statistics of L. Landsteiner. For the Jews we used the refugees from Monastir belonging to a people which came from Spain about 400 years ago. For the Greeks we examined 300 soldiers from Old Greece and the Islands and 200 refugees from Asia Minor and Thrace. For the Turks we used Macedonian Mahommedans. These last must certainly contain a large admixture of Slav blood, and the statistics should be confirmed in Turkey. We wish to emphasise particularly that all these people, except the Indians, who are as a nation for the most part vegetarians, are receiving exactly the same food and are exposed to the same hardships and diseases, so that it would not be correct to refer the great differences we have found in the frequency of A and B Groups to special climatological or pathological conditions.

Statistical Analyses.

We wish to point out as the first important fact that we found the Groups A and B present in all races examined. Table II. shows the percentage of A and B. The figures in the right-hand column of Table II. represent the total numbers of each race examined. A glance at the table shows that we find marked differences in the incidence of A and B in the different races. From the English onward we see that A always diminishes, whereas B increases.[4] In order to give an exact analysis we will first look at our data from the point of view developed by von Dungern and Hirschfeld in the second part of their paper.[5] The group A B was regarded by them as the accidental coming together of A and B. If we analyse our statistics from this point of view we reach the following figures: If A is present in 43·4 per cent. and B in 7·2 per cent. For the calculation of probability we must multiply 43·4/100 by 7·2/100, which gives 301/10,000 = 3·1 per cent. In reality we found 3·1 per cent.

TABLE II.

—	A in per cent.	B in per cent.	A B in per cent.	O in per cent.	Total No. examined.
English ...	43·4	7·2	3·0	46·4	500
French ...	42·6	11·2	3·0	43·2	500
Italians ...	38·0	11·0	3 8	47·2	500
Germans...	43·0	12·0	5·0	40·0	ca.500
Austrians	40·0	10·0	8·0	42·0	?
Serbs... ...	41·8	15·6	4·6	38·0	500
Greeks ...	41·6	16·2	4·0	38·2	500
Bulgarians	40·6	14·2	6·2	39·0	500
Arabs ...	32·4	19·0	5·0	43·6	500
Turks ...	38·0	18·6	6·6	36·8	500
Russians...	31·2	21·8	6·3	40·7	1000
Jews... ...	33·0	23·2	5·0	38·8	500
Malagasies	26·2	23·7	4·5	45·5	400
Negroes (Senegal)	22·6	29·2	5·0	43·2	500
Annamese	22·4	28·4	7·2	42·0	500
Indians ...	19·0	41·2	8·5	31·3	1000

TABLE III.

—	A B.		O.	
	Really found.	Calculation of probability.	Really found.	Calculation of probability.
	%	%	%	%
English ...	3·1	3·1	46·4	47·9
French ...	3·0	4·7	43 2	46·6
Italians ...	3·8	4·1	47·2	49·5
Germans...	5·0	5·1	40·0	43·1
Austrians	8·0	4·0	42·0	42·6
Serbs... ...	4·6	6·5	38·0	42·7
Greeks ...	4·0	6·7	38·2	43·4
Bulgarians	6·2	5·7	39·0	42·3
Arabs ...	5·0	6·1	43·6	47·5
Turks ...	6·6	7·0	36·8	39·9
Russians...	6·3	6·8	40·7	44·9
Jews... ...	5·0	7·6	38·8	44·5
Malagasies	4·5	6·2	45·5	49·5
Negroes (Senegal)	5·0	6·5	43·2	47·6
Annamese	7·2	6·4	42·0	45·3
Indians ...	8·5	7·8	31·3	43·7

Since A occurs in 43·4 per cent. and A B in 3·1 per cent., we have the property A altogether in 46·5 per cent., and correspondingly the non-A in 53·5 per cent. Similar calculations give for non-B 89·7 per cent. The calculation of probabilities thus gives for Group O: $\frac{53·5}{100} \times \frac{89·7}{100} = \frac{4798}{10,000} = 47·9$ per cent.

We actually found 46·4 per cent.

We made the same calculations for each people and race, and have shown the results in Table III. The table shows only slight differences between the calculation and the facts, the calculation giving somewhat higher results.

Basing our opinion on the whole of our material embracing about 8000 cases we look on Group O (the English Group IV.)

[3] L. Hirschfeld: Korrespondenzblatt für Schweizer Aerzte, 1917.

[4] In the English literature of the subject we find that the frequency of occurrence of B is higher and corresponds to the figures given by Landsteiner for Vienna. We cannot corroborate this. We examined our English material several times with seven different anti-B sera without finding a greater frequency than that here given.

[5] Loc. cit.

as the accidental conjunction of the two groups non-A and non-B, while Group I., our A B, is to be regarded as the accidental conjunction of the groups A and B. If, then, we wish to find exactly the frequency of A and B, we must add the English Group I. (our A B) to the Groups II. and III. Thus in the English subjects instead of 43·4 per cent. A, 7·2 per cent. B, and 3 per cent. A B, we read 46·4 per cent. A and 10·2 per cent. B.

In Table IV. the figures arrived at are shown diagrammatically, Group A being shaded and Group B black. The result is remarkable.

The prevalence of the Group A is characteristic of the European peoples. Most European peoples have not less than 45 per cent. A; in the Italians alone we found 41 per cent. This frequency of A only applies to Europe. In Africa and in Asia we find far fewer cases of A; the Russians and Jews 28 per cent. The Russians arranged according to districts show the following relationships:—

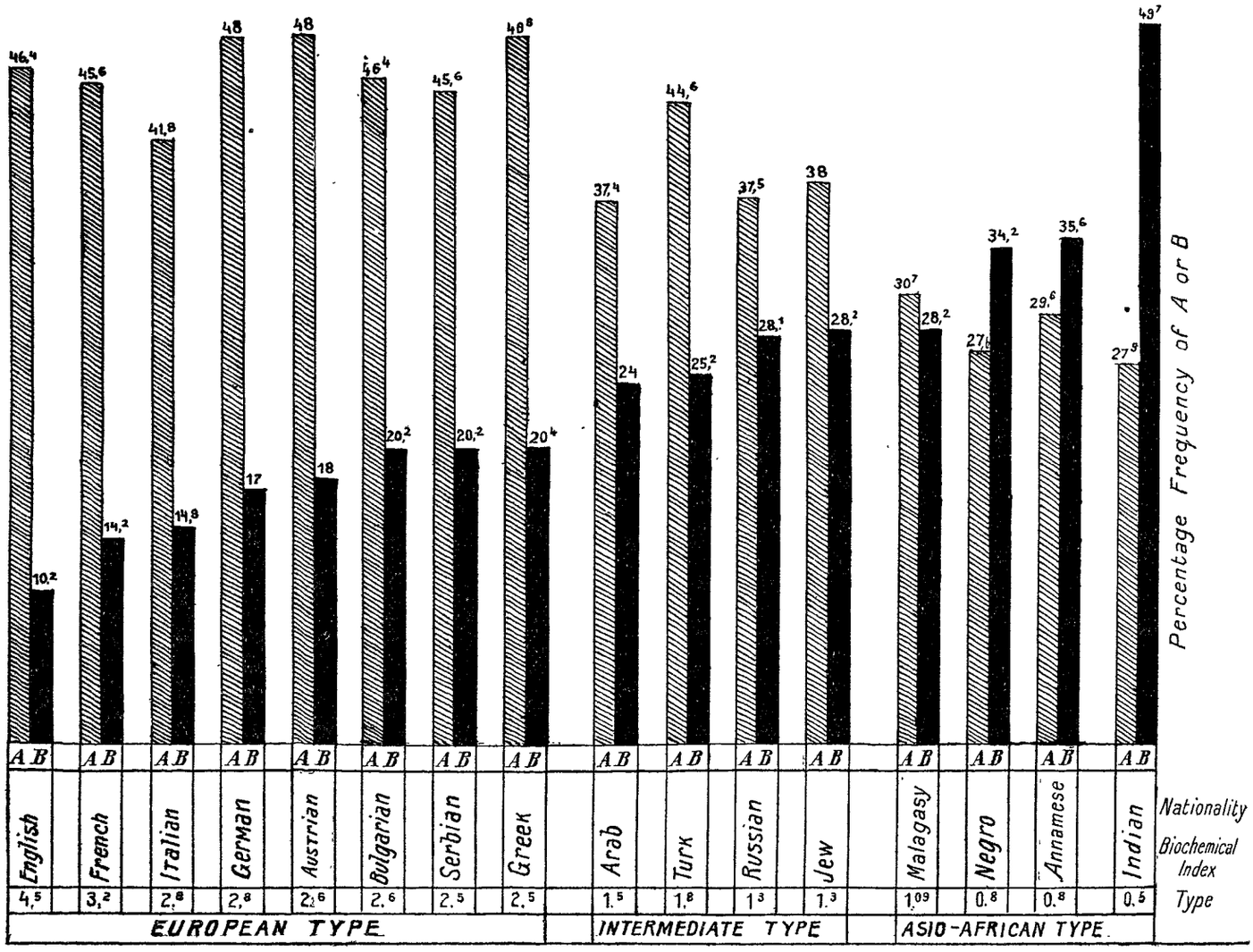
TABLE V.

—	A %	B %	Total.
Central Russia	37·6	25·2	400
Siberia	36·5	29·0	321
Ukraine	35·1	33·3	111
Perm, Vologda, &c.	36·8	34·5	84

Central Russia and Siberia show the intermediate type. Little Russia and the Volga District have the Asiatic type.

We see thus that A and B are present in different proportions in different races. The serological formula for a particular race is in no way affected by the anthropological

TABLE IV.—*Showing the Percentage Frequency of A and B Serological Reactions in Various National Types.*



Malagasies have 30 per cent., Negroes 27 per cent., Annamese 29 per cent., and Indians 27 per cent. of A. The countries lying between Asia and Central Europe, with the exception of the Macedonian Turks who have the European A frequency, show the intermediate type; the Arabs 37 per cent., the Russians 37 per cent., the Jews 38 per cent. Thus we see that going southwards and eastwards the frequency of A constantly diminishes. If we now consider Group B we find the exact opposite: the English who are farthest west have only 10 per cent., the French and Italians 14 per cent., the German Austrians 17 to 18 per cent. Of the Balkan peoples the Serbians and Greeks have the same frequency of 20·2 per cent. the Bulgars 20·4. The contrary is found in Africa and Asia. Group B, which is numerically low in Europe, reaches 28 per cent. in the Malagasies, in Negroes 34 per cent., in Annamese 35 per cent., and finally in Indians a maximum of 49 per cent. The peoples of the Mediterranean basin and the Russians in this also show the intermediate type: the Arabs have 24 per cent., Turks 25 per cent., characteristics. The Indians, who are looked on as anthropologically nearest to Europeans, show the greatest difference from them in the blood properties. The Russians and the Jews, who differ so much from each other in anatomical characteristics, mode of life, occupation, and temperament, have exactly the same proportion of A and B. On the other hand, it is clear that the distribution of A and B corresponds with surprising accuracy to geographical situation. The nearer to Western and Central Europe the more A and the less B, the nearer to Africa and Asia, especially to India, the less A and the more B. The peoples lying between Central and Western Europe on one side, and Africa and Asia on the other—that is to say, the peoples of the Mediterranean basin—show the intermediate type. In order to designate these relationships by a number we will call the proportion of A to B the biochemical race-index. We see that the race-index in the European peoples varies between 4·5 and 2·5, in the Asio-African peoples it is 1 or less, while the intermediate type is characterised by the race-index 1–2. (Table V.)

This remarkable fact, that A and B are represented in very different proportions in different races may be discussed from two standpoints. One can imagine that when man appeared on the earth A and B were present in the same proportions in different races. In this case the differences which are now present in different races would depend on the assumption that for unknown reasons A is more suitable for increased resistance of the organism to disease in a temperate climate, while B is more suitable in a hot climate. The hypothesis is improbable.

We see that the Russians in Siberia have the same proportion of B as the natives of Madagascar. The Jews who have lived for centuries in Monastir show a type of blood different from that of the other Balkan peoples. It is also a priori improbable that the climatic conditions should influence the frequency of A and B. If B could not be acclimatised in a temperate climate it should have died out in those climates long ago in the extended periods of time which we can take into consideration. It is very difficult to imagine one single place of origin for the human race in view of our statistics, since it would then be inexplicable why A diminishes from west to east and south, while B increases. The figures arrived at by us are most easily explained on the assumption that A and B had different points of origin and that there are two different biochemical races which arose in different places. In this case the mutual infiltration of these races is the cause of the varying proportion of A and B. Since the greatest frequency of B is found in India,[6] we should then look for the moment on India as the cradle of one part of humanity—namely, of the biochemical race B. Both to the east (Indo-China) and to the west, towards Europe and Africa, a broad stream of Indians poured out, ever lessening in its flow, which finally, although continually diminishing, penetrated to Western Europe. A similar single place of origin for A cannot be indicated, since all European peoples show a greater or less preponderance of A, which only seems to diminish somewhat in the Italians. Since, however, the Asiatic and African peoples are poor in A, we must assume hypothetically that A arose in North or Central Europe and spread out thence southwards and eastwards. A detailed examination of the northern races may lead us to unexpected and important conclusions on this point.

Conclusion.

We see then that the analysis of the figures we obtained has led us to remarkable results and that the highly interesting problem of a possible double origin of the human race has become a question which can be studied by means of serological methods. A problem of such dimensions may be propounded, but can hardly be resolved by the experimental results of a science, the introduction of which into these problems is here attempted for the first time. Still, we believe that we have shown in this paper that experiments in immunisation deserve to be made use of for the solving of anthropological questions. A close coöperation would be necessary between anthropologists and serologists, and the researches should be conducted on an international basis. The present war has brought so many races and peoples together that the main problems should certainly be capable of solution in a short time and without great labour. A series of important special researches, such as the examination of various stocks, primitive races, and anthropoid apes, should be begun without delay.

In our experiments we received much help from many medical and other officers of the Allied Armies in Macedonia. We owe our gratitude to the Directors of the Medical Services of the several armies for permission to examine soldiers and for other assistance. Major Stefanovitch and Captain W. L. Murphy, the liaison officers of the Serbian and British Army Medical Services, have undertaken the translation of the paper into English, for which we offer them our best thanks.

[6] Of the greatest importance are the researches from the Central Asia plateau.

THE War Office states that nurses whose names are mentioned in despatches for work in France, Egypt, or other places overseas will receive a certificate of the King's appreciation of their services.

TWO STUDIES OF MENINGOCOCCUS CARRIERS.

I.—THE SITE OF CARRYING IN CHRONIC MENINGOCOCCUS CARRIERS.

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II.—A STUDY OF 905 MENINGOCOCCUS CARRIERS.

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(*Reports to Medical Research Committee.*)

I.

THE "site of carrying" of the meningococcus has been investigated in 40 chronic carriers, 21 of these had already suffered from cerebro-spinal fever, 19 had never suffered from the disease, but had been found to be carriers on examination of the naso-pharynx. With only five exceptions these chronic carriers had been subjected to treatment with a Levick spray, charged with either chloramine or zinc sulphate daily for two months or more prior to this investigation. All the carriers were known to have carried for at least four weeks, the most chronic had been carrying for 15 months.

The naso-pharynx was illuminated by means of a forehead mirror and direct sunlight, material for culture being taken with a small-looped platinum wire from the various sites chosen. The patients were not exposed to any form of antiseptic treatment for 24 hours prior to examination. The sites chosen were:—

Through the nose.—Anterior ends of the lower turbinates, anterior ends of the middle turbinates, posterior ends of the lower turbinates, anterior wall of the sphenoid, fossæ of Rosenmüller upper, Luschka's tonsil.

Through the mouth.—Faucial tonsil crypts, fossæ of Rosenmüller lower, back wall of the naso-pharynx.

These sites were also strategical, as any discharge from the accessory sinuses of the nose would appear at one of these points. Thus discharge from the sphenoid sinus would appear on the front wall of the sphenoid; the discharge from the anterior ethmoidal, frontal, and maxillary sinuses over the anterior third of the lower turbinate; and the discharge from the posterior ethmoidal cells over the posterior third of the lower turbinate.

The utmost steadiness and care was required to obtain an uncontaminated loop through the obstructed nasal fossæ from the deep structures. Only such loops as were thought to be uncontaminated were used for culture. The following method of obtaining cultures from these sites was devised in order that the various parts examined might not be contaminated by infected material before they were themselves cultured.

The anterior end of the lower turbinate was cultured first, as it was accessible in every case. The anterior end of the middle turbinate was often hidden. Eucaine and adrenalin had to be applied in these cases to the anterior end of the lower turbinate before the middle turbinate could be seen and reached without contaminating the platinum loop. The posterior end of the lower turbinate was cultured after it was brought plainly into view by shrinking the anterior portion. Then the anterior wall of the sphenoid was exposed by shrinking the middle turbinate.

Up to this point a straight wire was employed, but for the investigation of the fossæ of Rosenmüller a platinum wire was bent slightly on the flat of the loop. The nasal orifices were held apart by a speculum, the wire was passed along the floor of the nose steadied against the speculum, with the loop well up from the floor. After the loop had passed by the posterior end of the lower turbinate and the Eustachian ring the wire was rotated, bringing the loop pointing towards the fossæ of Rosenmüller. The loop was