Periodicity in bird malaria has been confirmed for the Baltimore strain by Drensky and Hegner (1926).[2] Whether or not the period of the asexual cycle of the New York strain has become longer during its extended cultivation in canaries without asexual reproduction is not known. If we accept thirty hours as the length of the asexual cycle of the New York strain we can easily compute the number of asexual generations this strain has passed through since it was obtained in 1913. This period consisted of slightly over twelve and one half years, or about 109,440 hours. Dividing this number by 30 gives 3,648, which is approximately the number of asexual generations this strain passed through during that period without the intervention of sexual reproduction.

If we accept twenty-four hours as the length of the asexual cycle in the Baltimore strain the data are as follows: total period, about one year and one half; number of days, about 550; number of asexual generations, about 550. Whitmore reported, in 1921,[3] that three of his canaries remained infected with the New York strain for twenty-nine months (until their death) after they were inoculated—a period during which about 700 asexual generations must have taken place in a single host. Mazza (1924)[4] records a bird that was still infective four years and two months after the original inoculation, but the number of asexual generations can not be computed in this case because the length of the asexual cycle is unknown for his strain.

The length of the asexual cycle is known for the organisms of human malaria; that of *Plasmodium vivax,* which causes tertian malaria, is forty-eight hours; that of *P. malariæ,* of quartan malaria, is seventy-two hours; and that of *P. falciparum,* of estivoautumnal malaria, is twenty-four to forty-eight hours. It seems certain that asexual reproduction continues at the same rate throughout human infections as it does in those of birds, hence the number of asexual generations may be calculated approximately by dividing the number of days of the infection by the length of the asexual cycle of the species concerned. It is of course necessary to prove that the infection measured is due to one group of parasites and not to sporozoites inoculated by mosquitoes subsequent to the original infection.

The rate of asexual reproduction is usually accepted by protozoologists as a measure of the vitality of a strain. This rate has been shown to be maintained by the Baltimore strain of *Plasmodium praecox* for over a year and there is every reason to believe that the rate will not decrease to any considerable extent in the future. Another criterion of vitality exists among parasitic protozoa and that is virulence. The evidence shows that both the New York and Baltimore strains have maintained their virulence throughout the entire period since they were secured. A factor of interest in regard to the rate of reproduction and virulence observed is the constant environment in which the malarial organisms live.

Does reorganization take place during asexual reproduction in *Plasmodium praecox?* This is a question that can not be answered. No such phenomenon is known, but this does not prove that a reorganization process is absent since we know very few of the cytological details of the malarial parasites during reproduction. We do know that a differentiation takes place in the blood, resulting in the production of sexual cells from the asexual generation, but as stated above these sexual cells do not continue development in the blood. Perhaps other changes corresponding to endomixis occur at some stage during the growth of the schizonts or when the merozoites are formed.

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CERAMIC PIGMENTS OF THE INDIANS OF THE SOUTHWEST[1]

THE chemical nature of the coloring matter used by the ancients as ceramic pigments has been definitely established in a great many instances, but the small quantities available for analysis have frequently served as a barrier to their identification. As a matter of fact, the literature on this subject is very meager. The Encyclopaedia Britannica[2] states that all the black pigments ordinarily used contain carbon as the principal constituent. They are ivory black, lamp black, charcoal black, india ink and graphite (sometimes called black lead or plumbago). The same publication[3] in an article on Italian ceramics after the year 1200 A. D. states that black was made from a mixture of various colors. These included antimonate of lead for the yellow, ferric oxide for the red, copper oxide for the green, oxide of cobalt for the blue and manganese for the brownish purple.

Robbins, Harrington and Freire-Marreco[4] state that the modern Tewa Indians use a black paint for the decoration of pottery made from the Rocky Moun-

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[2] Drensky, Kosta, and Hegner, R. W., 1926, "Periodicity in Bird Malaria," *Amer. Journ. Hyg.*, 6: 312–314.

[3] Whitmore, E. R., 1921, "Observations on Bird Malaria and the Pathogenesis of Relapse in Human Malaria," Johns Hopkins Hosp. Bull., 29: 62–67.

[4] Mazza, S., 1924, "On the Duration of Relative Immunity in Malaria of Birds," *Journ. Trop. Med. and Hyg.*, 27: 98–99.

[1] From the Department of Chemistry, University of Colorado, Boulder, Colorado.

[2] Encyclopaedia Britannica, 21, 598 (1911).

[3] Encyclopaedia Britannica, 5, 737 (1911).

[4] "Ethnobotany of the Tewa Indians," Bureau of American Ethnology, Bulletin 55, 58 (1916).

tain bee plant or guaco (peritoma serrulatum). Wissler,[5] while speaking of the Indians of the Southwest, says, "Here we find the paints of both vegetable and mineral origin, the reds and yellows from iron, the blacks from the juices of plants. By proper firing, the desired colors could be made permanent." Wissler was here no doubt referring only to the Indians of to-day, although his statement has been interpreted as referring to the prehistoric Indians as well. Watson[6] has studied the modern art of the making of pottery of the Tewa Indians, and states that the black pigment is obtained by boiling down the juice of the bee plant until it becomes black and thick. After the dried unburned utensils have been decorated with this liquid, they are fired by placing them on stones in the middle of a bed of coals, piling flat pieces of manure around and over them, and leaving them there for about an hour. They are then polished by rubbing grease over them before they are cold. At the museum of the American Indian in New York there is on exhibit a long needle cactus. Near it is a tube containing a thick black liquid which is indicated as coming from it and as being used in decorating pottery by the Indians of the Southwest. The mode of preparation is no doubt the same as in the case of the paint of the bee plant. Various authorities have questioned the possibility of such organic coloring materials being used and withstanding the temperature of firing. However, such arguments could not be advanced in the case of the firing at such a low temperature as the Tewas of to-day use.

The fact that present-day Indians use a black of vegetable origin has apparently caused investigators to lose sight of the work of Nordenskjöld,[7] who made a rather extensive study of the pigments used by the cliff dwellers. A qualitative analysis led him to believe that the red pigment was the iron sesquioxide Fe_2O_3. He states that the red and yellow colors come from iron ochers prepared in stone mortars, the various shades being the result of various degrees of burning. Nordenskjöld found a large spherical vase at the Step House in the Mesa Verde whose decoration was so thick that he could scrape off enough for analysis. It was found to be an iron base and he concluded that it was probably the magnetic oxide Fe_3O_4. He also states that in one of the ruins he picked up a piece of wood several centimeters long, at the end of which there was still attached a reddish substance, which he analyzed. It was found to be a resin mixed with iron ocher. He thus explained that this resin reduced the red oxide to the black oxide.

Kidder and Guernsey[8] in their report on archeological explorations in northeastern Arizona state that the pigment is a clear dull black, with a slightly bluish or slaty cast. No analyses were made, but they assumed it was an iron product as determined by Nordenskjöld.

Several years ago Mr. Earl H. Morris, who was at that time curator of the Aztec Ruin National Monument, asked the author to determine the composition of the black pigment used by the Chaco and Mesa Verde Indians. For this work he furnished a box of potsherds which were in a very good state of preservation.

The best method of removing the thin layer of coloring matter was found to be by means of hydrofluoric acid. This loosened it to such an extent that it could be very easily washed off. Comparative analyses were made of both the pigment and the body of the pottery. Manganese, which might have been responsible for the color, was found to be lower in the pigment than in the clay. The most prominent element in the surface was iron. After considerable effort it was found possible to scale off thin flakes of the black pigment, which were magnetic and which became non-magnetic on heating in the oxidizing flame. Conversely, a potsherd covered with a bright red pigment, blackened on heating in the reducing flame, while becoming magnetic. One piece of red pottery was found blackened on the under side. It looked as if it had been smoked up over a fire, but this was not the case, as the black was magnetic. It was either the result of the reducing gases which were present at the bottom at the time of firing or at some later time while in use over an open fire.

One of the potsherds with a black design was fired in a furnace at about 1,000° C., with the result that the design became a dull red on a lighter background, showing that the original firing must have been at a comparatively low temperature.

It is therefore evident that the black pigment of the prehistoric Indians of the Southwest was the sesquioxide of iron, commonly known as magnetite, while the red pigment was the mineral hematite.

The use of the two oxides of iron for the production of black and red pigment, as well as the control of the processes of oxidation and reduction is to be regarded as a rather notable scientific achievement of the Indians.

It is also interesting to note that the use of hematite as the cheap barn paint of to-day must date back to very early times.

The author wishes to take this occasion to thank Mr. O. B. Muench for his assistance in making some

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[5] "The American Indian," Clark Wissler, 72 (1917).

[6] *Art and Archeology*, 9, 24 (1920).

[7] G. Nordenskjöld, "The Cliff Dwellers of the Mesa Verde," Stockholm, 1893.

[8] Bulletin of the Bureau of American Ethnology, 65, 130 (1919).

of the analyses, and Dr. E. B. Renaud for some of the literature references.

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THE NATIONAL ACADEMY OF SCIENCES

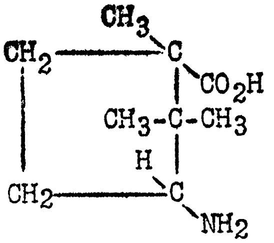
At the annual meeting of the National Academy of Sciences held in Washington, on April 26, 27 and 28, the following papers were presented:

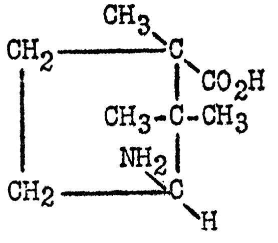
A crystalline-diazo compound of the camphor series: William A. Noyes and Forrest E. Kendall.

Chiles and Noyes (*J. Amer. Chem. Soc.*, *44*, 1798 (1922)) succeeded in preparing six optically active, aliphatic diazo compounds in which the only asymmetric carbon atom was that connected with the diazo group. Levene and Mikeska (*J. Biol. Chem.*, *55*, 595 (1923)) have also obtained optically active diazo compounds, though they failed to confirm some of the work of Noyes and Chiles.

The diazo compounds prepared were all liquids and had small rotatory power. It seems very desirable to prepare crystalline compounds, if possible, and also compounds giving a greater rotation.

It seemed possible to realize these conditions by the preparation of diazo compounds from *cis-* and *trans-*aminocamphonanic acids, which have the following configurations:





cis-Aminocamphonanic acid *trans*-Aminocamphonanic acid

The diazo compound of the methyl ester of the *cis* acid has been obtained by treating an etherial solution of the anhydride of the acid with sodium methylate, washing the solution of the diazo compound with water, freezing out the water at - 80°, concentrating in a current of dry, carbon dioxide-free air at a low temperature and crystallizing from ether at - 80°. So far as we have been able to learn, this is the first diazo compound having the group in the gamma position with reference to an ester group. The compound has a rotation of approximately 410.

To demonstrate the asymmetry of the diazo group in this compound it will be necessary to prepare the corresponding compound from the *trans* isomer. The work on this is not yet complete.

Atomic formation and disintegration, and separation of isotopes: Professor W. D. Harkins.

The synthesis of 2-phenyl-benzoselenazole-4′-arsonic acid and of some other benzoselenazoles: Professor Marston Taylor Bogert and Arthur Stull.

o-Chloronitrobenzene is converted into the o-nitrophenyl diselenide and the latter reduced to the zinc salt of o-aminophenyl selenophenol. By the action of aldehydes or acid halides upon this amino selenophenol, benzoselenazoles are obtained in excellent yield. When nitrobenzaldehydes or nitrobenzoyl chlorides are employed, 2-nitrophenyl-benzoselenazoles result, which can be readily reduced to the corresponding amino derivatives. Application of the Bart reaction to these amines gives the corresponding arsonic acids, the alkaline salts of which are freely soluble in water and are now being tested pharmacologically.

The products are therefore water-soluble organic arsenicals containing selenium as part of the molecule, and represent one phase of the exploratory work now being conducted at Columbia University to determine the therapeutic value of organic selenium derivatives as well as to gain additional knowledge concerning the chemistry of this group.

The alleged constancy of our physico-chemical constants; the metastability of naphthalene: Ernst Cohen, George Henry Brandes and John Calvin Keller (by invitation).

New evidence in favor of a dual theory of metallic conduction: Professor Edwin H. Hall.

Professor Bridgman has recently discovered a development of Peltier effect heat where an electric current changes direction within a metal crystal, and he has expressed the opinion that none of the well-known theories of electric conduction would lead us to expect such an effect. The dual theory, by means of a formula published several years ago, readily explains this phenomenon, as Professor Bridgman at once admitted when this formula was brought anew to his attention.

Professor Millikan has still more recently announced that, by experiments and reasoning of his own, he has been led to the conclusion that most of the electrons which maintain an electric current within a metal do not share the energy of thermal agitation, while the thermions, which he thinks responsible for thermoelectric action, do share this energy. This evidence appears to give strong support to conceptions which have long been held and repeatedly expressed in the development of the dual theory.

Applied to the results of Bridgman's experiments on the electrical and thermal behavior of metals under high pressure, the dual theory appears to be helpful in establishing a rational relation between the various effects observed.

Determination of excitation potentials of soft X-rays: K. T. Compton and C. H. Thomas, Princeton University.

By soft X-rays we refer to radiation emitted from solids when bombarded by electrons whose energies correspond to a fall through potential differences from 5