

form, or stick lac; shell and button lac are made, to some extent, but lac dye is not now prepared anywhere in Assam, and lacquer wares are only produced in two places, so that this once considerable industry would seem to be dying out. The black lacquer of Manipur is really not a lac preparation at all, but only the juice of a tree sent from the Kubo Valley. In Assam the lac is usually collected twice a year, first in May and June, and then in October and November. The first is mainly used for seed purposes, while the second forms the export. A few days after the collection, pieces of stick lac containing living insects are tied on to the branches of the trees on which the next crop is to be grown. The usual plan is to place the lac in small bamboo baskets and tie these on the twigs of the trees. The insects soon crawl out, and spread over the young branches, on which they promptly begin to feed, and secrete the resin. This is allowed to go on for about six months, when the lac is collected; but if the secretion has been defective or insufficient, the insects remain undisturbed for another six months.

EXPLOSION OF POTASSIUM CHLORATE.

To the Editor of the SCIENTIFIC AMERICAN SUPPLEMENT:
In a late issue, January 5, of the SUPPLEMENT there appears an article on the "Explosion of Potassium Chlorate."

As stated, the salt explodes readily in a hydrocarbon flame, either a common lamp or a Bunsen flame producing the decomposition.

The experiment is very instructive and may be used with advantage before elementary classes when studying the artificial production of oxygen by the decomposition of a mixture of KClO_3 and MnO_2 .

The experiment is best performed as follows: A small loop of platinum wire, such as is used in blow-pipe analysis, is loaded with a crystal of the salt. This is then introduced into the center of a Bunsen flame and gradually fused by raising it into the upper part of the inner cone. Here the exact conditions obtain which are provided in the more elaborate experiment, namely, a temperature higher than the commencing of the decomposition. If now the bead is lifted into the hottest part of the flame, the explosion will take place as described. It is essential that the salt be entirely fused, else the explosion will be retarded and preceded by a sputtering of smaller explosions.

The great advantage in performing the experiment after this fashion arises from the fact that the explosion can be more carefully studied. After the decomposition a film of KCl will be found over the platinum loop.

The experiment is valuable in that it illustrates the dissociating effects of heat in general, and also indirectly the modifying effects of MnO_2 in the production of oxygen by our common methods.

WILLIAM A. DAVIES,
Of Denison University.

ARGON AND ITS COMPANIONS.*

THE discovery of krypton and neon was announced to the Royal Society in the early summer of 1898; and subsequently atmospheric air was found to contain a heavier gas to which the name of xenon was applied. Mr. Baly, in the autumn of the same year, called attention to the presence of helium lines in the spectrum of neon, an observation which confirms that made by Prof. Kayser, of Bonn, and by Dr. Friedländer, of Berlin.

At the same time we imagined that we had obtained a gas with a spectrum differing from that of argon and yet of approximately the same density; to this gas we gave the name metargon. It has now been found that the presence of the so-called metargon is to be accounted for by the fact that in removing oxygen from the mixture of these gases, which was then in our hands, phosphorus containing carbon was employed; this mixture when burned in oxygen yields a spectrum to some extent identical with that furnished by carbon monoxide, but differing from it inasmuch as lines of cyanogen are also present. We have no doubt that the so-called metargon, the spectrum of which is visible only at high pressure, and only when impure phosphorus has been employed to remove oxygen, must be attributed to some carbon compound. In spite of numerous experiments we have not yet succeeded in producing any gas in quantity which yields this composite spectrum. It is only to be obtained by a mixture of carbon monoxide with cyanogen.

To obtain the heavier gases krypton and xenon, a large amount of air was allowed to evaporate quietly; the residue was freed from oxygen and nitrogen, and then consisted of a mixture of krypton, xenon, and argon, the last forming by far the largest portion of the gas; this mixture was liquefied by causing it to flow into a bulb immersed in liquid air, and the bulk of the argon was removed as soon as the temperature rose, the krypton and the xenon being left behind. By many repetitions of this process we were finally successful in separating these three gases from each other. While krypton has a considerable vapor-pressure at the temperature of boiling air, the vapor-pressure of xenon is hardly appreciable, and this afforded a means of finally separating these two gases from one another; in the complete paper the operations necessary to separate them are fully described.

For neon the process of preparation was different. The air liquefier furnished a supply of liquid air; the gas escaping from the liquefier consisted largely of nitrogen; this mixture was liquefied in a bulb immersed in the liquid air which the machine was making. When the bulb had been filled with liquid nitrogen a current of air was blown through the liquid until some of the gas had evaporated. That gas was collected separately, and deprived of oxygen by passage over red-hot copper; it contained the main portion of the neon and the helium present in the air. The remainder of the nitrogen was added to the liquid air used for cooling the bulb in which the nitrogen was condensed. Having obtained a considerable quantity of this light nitrogen it was purified from that gas in the usual man-

ner, and the argon containing helium and neon was liquefied. By fractional distillation it was possible to remove the greater portion of the helium and neon from this mixture of gases, leaving the argon behind. Many attempts were made to separate the helium from the neon. Among these was fractional solution in oxygen, followed by a systematic diffusion of the two gases; but it was not found possible to raise the density of the neon beyond the number 9.16, and its spectrum still showed helium lines. It was not until liquid hydrogen, made by an apparatus designed and built by one of us (M. W. T.), had been produced in quantity, that the separation was effected; the neon was liquefied or perhaps solidified at a temperature of boiling hydrogen, while the helium remained gaseous. A few fractionations serve to produce pure neon; we did not attempt to separate the helium in a pure state from this mixture.

That these are all monatomic gases was proved by determination of the ratio of their specific heats by Kundt's method; the physical properties which we have determined are the refractivities, the densities and the compressibilities at two temperatures, and of argon, krypton, and xenon the vapor-pressures and the volumes of the liquids at their boiling points.

The results are as follows:

	Helium.	Neon.	Argon.	Krypton.	Xenon.
Refractivities (Air=1) ...	0.1238	0.2345	0.968	1.449	2.364
Densities of Gases ($O=16$)	1.98	9.97	19.96	40.88	64
Boiling-points at 760 mm.	?	?	86.9° abs.	121.33° abs.	163.9° abs.
Critical temperatures ...	?	below 68° abs.	155.6° abs.	210.5° abs.	287.7° abs.
Critical pressures ...	?	?	40.2 metres	41.24 metres	43.5 metres
Vapour-pressure ratio ...	?	?	0.0350	0.0467	0.0675
Weight of 1 c.c. of liquid	?	?	1.212 grammes	2.155 grammes	3.52 grammes
Molecular volumes ...	?	?	32.92	37.84	36.40

The compressibilities of these gases also show interesting features. They were measured at two temperatures—11.2 degrees and 237.3 degrees; the value of P.V. for an ideal and perfect gas at 11.2 degrees is 17,710 meter-cubic-centimeters, and at 237.3 degrees to 31,800. This is, of course, on the assumption that the product remains constant whatever be the variation in pressure. Now with hydrogen at 11.2 deg. C. the product increases with the rise of pressure; with nitrogen, according to Amagat, it first decreases slightly and then increases slightly. With helium the increase is more rapid than with hydrogen; with argon there is first a considerable decrease followed at very high pressures by a gentle increase, although the product does not reach the theoretical value at 100 atmospheres pressure; with krypton the change with rise of pressure is a still more marked decrease, and with xenon the decrease is very sudden. At the higher temperature the results are more difficult to interpret; while nitrogen maintains its nearly constant value for P.V., helium decreases rapidly, then increases, and the same peculiarity is to be remarked with the other gases, although they do not give the product of P.V. coinciding with that calculable by assuming that the increase of P.V. is proportional to the rise of absolute temperature.

These last experiments must be taken as merely preliminary; but they show that further research in this direction would be productive of interesting results.

The spectra of these gases have been accurately measured by Mr. E. C. C. Baly, with a Rowland's grating; the results of his measurements will shortly be published. It may be remarked, however, that the color of a neon-tube is extremely brilliant and of an orange-pink hue; it resembles nothing so much as a flame; and it is characterized by a multitude of intense orange and yellow lines; that of krypton is pale violet; and that of xenon is sky-blue. The paper contains plates showing the most brilliant lines of the visible spectrum.

That the gases form a series in the periodic table, between that of fluorine and that of sodium, is proved by three lines of argument:

(1) The ratio between their specific heats at constant pressure and constant volume is 1.66.

(2) If the densities be regarded as identical with the atomic weights, as in the case with diatomic gases such as hydrogen, oxygen, and nitrogen, there is no place for these elements in the periodic table. The group of elements which includes them is:

Hydrogen.	Helium.	Lithium.	Beryllium.
1	4	7	9
Fluorine.	Neon.	Sodium.	Magnesium.
18	20	23	24
Chlorine.	Argon.	Potassium.	Calcium.
35.5	40	39	40
Bromine.	Krypton.	Rubidium.	Strontium.
80	82	85	87
Iodine.	Xenon.	Cæsium.	Barium.
127	128	133	137

(For arguments in favor of placing hydrogen at the head of the fluorine group of elements, see Orme Masson, Chem. News, vol. lxxiii., 1896, page 283.)

(3) These elements exhibit gradations in properties such as refractive index, atomic volume, melting-point and boiling-point, which find a fitting place on diagrams showing such periodic relations. Some of these diagrams are reproduced in the original paper. Thus the refractive equivalents are found at the lower apices of the descending curves; the atomic volumes, on the ascending branches, in appropriate positions; and the melting and boiling-points, like the refractivities, occupy positions at the lower apices.

Although, however, such regularity is to be noticed, similar to that which is found with other elements, we had entertained hopes that the simple nature of the molecules of the inactive gases might have thrown light on the puzzling incongruities of the periodic table. That hope has been disappointed. We have not been able to predict accurately any one of the properties of one of these gases from a knowledge of those of the others; an approximate guess is all that can be made. The conundrum of the periodic table has yet to be solved.

MAMMALS AND REPTILES; OR, WHAT WAS THE ICE AGE?

By JOSHUA RUTLAND.

THE largest existing species of mammals and reptiles are aquatic, many of them being especially adapted to the water and unable to exist on land; thus the great Cetacea head the former, the crocodile and sea-turtle the latter division of the animal kingdom. If from this seeming anomaly among air-breathing animals we turn to the geographical distribution of the aquatic species, we discover an important difference. To the cold seas of the high latitudes the large Cetacea chiefly belong, while the large aquatic reptiles are strictly confined to the rivers, lakes and seas of tropical or sub-tropical countries.

This difference in the distribution of the two orders is not limited to the aquatic species, for we find it even more pronounced when terrestrial species are examined. Proceeding from the equator toward the poles, after quitting the tropics, reptiles diminish rapidly both in size and in the number of species, the reptilian fauna of the colder portion of the temperate zone being comparatively meager. Within the Arctic Circle the order is represented by a single species, the common British frog, *Rana temporaria*, which in Norway ranges to about seventy degrees north. On the other hand, many large mammals such as the polar bear, musk ox, and reindeer, are permanent inhabitants of the north frigid zone, the mammalian fauna of the adjacent temperate zone being very numerous and extremely varied. This difference in the geographical distribution clearly denotes a difference between warm and cold blooded air-breathing animals, a conclusion which is further strengthened when the distribution and habits of birds are taken into account. A few birds winter within the Arctic Circle, and many resort there or migrate from low to high latitudes during the breeding season, proving that the summer temperature of the warmer zones is unfavorable to their increase.

Turning now to the portion of the earth's history gathered from geological sources:

During what has been termed the reptilian period, reptiles larger than any existing species inhabited the seas of the temperate zone. In Spitzbergen and in the New Zealand archipelago sedimentary rocks of marine origin contain numerous remains of the ichthyosaurus and plesiosaurus, animals adapted to the ocean like the cetacean of the present day. Associated with these remains are large mollusca, corals and other organisms now restricted to tropical seas.

While these great saurians dominated the ocean other reptiles were as widely distributed on land, occupying places now monopolized by warm-blooded animals. Huge pterodactyls traversed the air like birds, and the unwieldy iguanodon fed upon the herbage like our modern ruminants.

From the same geological sources we learn that Greenland had formerly a generous vegetation, the remains of plants resembling the Sequoie, magnolias and laurels of the New World being found embedded in the rocks of that now inhospitable clime. In the New Siberian Islands a seam of bituminous coal proves that dreary region was once clothed with verdure, while fossil plants akin to palms and pandanus grew in England and on the adjacent continent, showing that the flora of Northern Europe had at some time what we would now term a tropical aspect.

The most important facts in the history of the Tertiary period are the decrease of reptiles and the increase of mammals. At the commencement of the period, before the great marine saurians finally disappeared, the fauna of Europe included many arboreal mammals of types now confined to the tropical regions of the Old and New World. Toward the middle of the period swift-footed herbivora resembling the antelopes of Africa became numerous, and these as the period drew to a close gave place to forms still found throughout the north temperate zone.

During the Ice Age immediately after the close of the Tertiary period terrestrial mammals attained their greatest development; the mammoths and mastodons preserved in the frozen soil of Siberia and Northern America surpassed in bulk all existing species. To the commencement of this rigorous period the first positive traces of man must also be assigned.

Since the passing away of the glacial cold, besides the mammoths and mastodons, several large mammals such as the cave bear, woolly rhinoceros, which existed contemporaneously with primitive man, have disappeared, and others like the reindeer, which during the Ice Age ranged into Southern France, have altered their habitat, but no great change in the general character of the fauna analogous to the displacement of reptiles and mammals has taken place.

In considering the great climatic changes above referred to, we must first determine whether the ice age was really a distinct period due to special causes or merely the climax of a long and gradual cooling down of the earth's climate taken as a whole. In either case the present climatic condition must be the result of causes in some measure the reverse of those which brought on the glacial cold.

The limited distribution of aquatic reptiles compared with the distribution of aquatic mammals is evidently not due to their being unable to cross wide expanses of ocean, for marine turtles are frequently found on the New Zealand coast, a large specimen being quite recently captured in Tory Channel (Middle Island). Yet turtles have not established themselves in the New Zealand seas. As water snakes and other marine reptiles are also found far outside their proper

* A paper by Prof. William Ramsay, F.R.S., and Dr. Morris W. Travers. Read at the Royal Society on November 15, 1900. Abstract in Nature.

latitudinal range, in the absence of any other adequate cause we must conclude that these animals are unable to adapt themselves to the colder water of the temperate zone, hence their restricted diffusion. Unless the great pelagic reptiles of the secondary geological period were constitutionally different from the modern marine reptilia, the general temperature of the ocean when they existed must have been far higher than it is at present, for the presence of their remains in the northern and southern hemispheres denotes a distribution which could not have been due to any local increase of heat.

If the mean temperature of the ocean was high, it is evident from the effects of the Gulf Stream and other oceanic currents that the mean temperature of the atmosphere must have been correspondingly high, a condition necessary to account for the extraordinary development and distribution of terrestrial reptiles when the great saurians occupied the deep.

Reptiles attained their maximum development during the Mesozoic period, but to discover their advent we must go back to the preceding Palæozoic era, when the order was represented by amphibians, a group of animals having much in common with fishes—the dominant or characteristic order of the Carboniferous and Devonian sub-periods. In like manner, though mammals especially characterize the Tertiary and subsequent periods their history extends far back into the age of reptiles, which might also be designated the age of marsupials. It was at that time the lowest subdivision of the mammalia was most widely distributed.

At present marsupials are confined to the warm portion of the New World—where about twenty species, all belonging to the family Didelphis, exist—to Indonesia and to Australia, including New Guinea and Tasmania. In Australia marsupials still characterize the fauna, filling places elsewhere occupied by placenta, carnivora, herbivora, insectivora and rodents. The peculiarities of the Australian fauna are generally attributed to an isolation which some writers date back to Mesozoic times, but excepting the absence of placental mammals the production of the region taken as a whole corresponds with the rest of the world. The flora is an assemblage of dicotyledons, monocotyledons and cryptogams; among the birds the raptures, scansores, volitantes, cantores, rasores, crallatores, natatores and cursors are all well represented. The numerous reptiles are even less distinctive than the birds, being all of the modern types—crocodilia, orphidia, lacertilia, chelonina and batrachia.

If the fierce Carnivora, well-armed ruminants and powerful Omnivora in the neighboring Asiatic regions had access to Australia, the comparatively defenseless marsupials would have disappeared or would have been reduced to a few species capable of maintaining their existence by concealment or flight. The isolation which enabled the warm-blooded marsupials to survive through the Tertiary period down to our own times did not preserve a single species of their ancient contemporaries, the reptiles of the Mesozoic era; we must therefore conclude that the extinction of these cold-blooded animals was due to causes against which even ocean barriers were ineffective.

The great gap in the geological history of the northern hemisphere between the Cretaceous and Eocene periods has left us ignorant of how the Mesozoic fauna and flora passed into the fauna and flora of the succeeding Tertiary era. From widely separate sources such as the Maestricht beds, rocks at Aix-la-Chapelle and the Cretaceous-Tertiary formation of New Zealand, which may be compared to the scattered leaves of a lost volume, we learn that before the great pelagic saurians disappeared, dicotyledonous plants were universally distributed. Among the fossils discovered at Aix-la-Chapelle are the remains of plants resembling the oak, walnut and fig, now characteristic of the European region, intermingled with remains that have been referred to the order Protaceæ now largely represented in Australia. Evidently before the age of reptiles finally closed the earth or a great portion of it was clothed with the same assemblage of cryptogams, monocotyledons and dicotyledons which everywhere now prevails. Though these three forms of vegetable life are universally dispersed in the distribution of the arborescent species, there is a marked difference, dicotyledonous trees ranging into much higher latitudes than arborescent monocotyledons or tree ferns, the only cryptogams which at present attain tree-like dimensions.

Since the commencement of the Tertiary period cetaceans have been the largest denizens of the deep. From Eocene deposits of the United States whole skeletons of a Zeuglodon about seventy feet in length have been recovered. The Cetacea naturally fall into two divisions, the toothed whales and the Balæniæ, from which whalebone is obtained; to the former division the Zeuglodon belong, no traces of the Balæniæ have been discovered in rocks older than the Miocene period, when the group was represented by species from two to ten feet long. At present toothed whales are found in all seas from within the Arctic to within the Antarctic circles, but the largest existing species, the sperm whale, is mostly confined to the warm seas of low latitudes; on the other hand, the largest representatives of the Balæniæ, the right whale as they are popularly styled, belong strictly, in both hemispheres, to the polar and adjacent seas. The Prociæ, like the Cetacea, are found in every zone, but more especially in the cold seas of temperate and polar regions. The largest species, the sea-elephants of the southern hemisphere and the Arctic walrus, are confined to high latitudes. Carnivora were numerous in Eocene times, but no traces of the extremely specialized pinnigrade have been discovered in deposits older than Pliocene, their remains being most abundant in Quaternary and recent formations. The Ungulates like the cetaceans take us back to the earliest Tertiary times, when both Perissodactyla and Artiodactyla were already well represented. The modification of the ancient Eocene types into the highly specialized animals of the present day can only be accounted for by changes in the environment, compelling adaptation by natural selection. From two such distinct lines the Perissodactyla and Artiodactyla, culminating in swift forms

like the various species of Equus and the antelopes, deer, etc., especially adapted to open pastures, we must conclude that the causes had been long in operation and were general in their effects.

From the Eocene deposits of England, France and other parts of Europe, remains of several species of Palæotherium have been obtained. Some of these animals which resembled the modern tapir, having like it a short prehensile trunk, were about the size of a horse and inhabited marshy ground, being partly aquatic in their habits. The tapirs, of which there are four or five species, belong exclusively to the warm regions of the Old and New Worlds, a distribution characteristic of mammals that can be referred to very ancient types; thus the Lemuroidea, confined to Madagascar, Africa and Indonesia, are descended from animals distributed during the Eocene period over Europe and North America. The early Tertiary artiodactyles, of which the Charopotamus is an example, were principally omnivora, a subdivision of the Ungulata, now reduced to the comparatively small family Suina, including some very distinct genera such as the wart hogs of Africa, the peccaries of America and the babyroussa of the Malay Archipelago. The Suina generally belongs to warm countries, but one species, Sus scrofa, or wild boar, ranges over the temperate portions of Europe and Asia and was formerly plentiful in the British Islands.

Of the true herbivora, which constitutes such a large proportion of existing faunas, we have no positive evidence before the Middle Tertiary period; since then the species have steadily increased until we find them occupying level plains and mountain heights within the torrid, temperate and frigid zones. Among the horned herbivora three distinct types can be recognized, antelopes and the hollow-horned and antlered ruminants; of these the antelopes are the most ancient, numerous remains of animals resembling the modern gazelles, gemsbok and koodoos occurring in the Miocene deposits of Europe, especially of Southern Europe. In the British Islands only one species, a gazelle, has been discovered, and none has been found on the American continents. The antelopes belong chiefly to warm latitudes and are especially characteristic of the African region, from whence between eighty and ninety species have been described. Asia possesses about fifteen species, mostly southern, though some range over the whole continent. Europe and North America have each two species, while in South America they are entirely wanting. The ruminants, including the buffaloes, bison, oxen, sheep, goats and deer, are very widely distributed over both the eastern and western hemispheres. In the African region, to which more than four-fifths of the antelopes belong, only two species, Bubalus Caffar and B. brachyceros, are found, the deer, Cervus Dama and C. Elaphus, inhabiting the northern portion of the continent being most likely introduced during the Roman occupation. Herodotus, whose descriptions are generally reliable, says: "The stag and the wild boar are never seen in Lybya." Of the north temperate and Arctic zones, the ruminants are especially characteristic, the reindeer and moose being circumpolar in their ranges.

The earliest remains of the branched and hollow-horned herbivora have been discovered in European Pliocene deposits, but probably the simple horned Palæomeoryx of the Miocene period were the ancestors of our modern deer.

At the close of the Tertiary and throughout the Quaternary period ruminants, at least generically allied to existing species, must have been important features in the faunas of Eurasia and North America, judging by the abundance of their remains. As these generic types survived the glacial epoch, and many of the species along with other contemporaneous mammals moved into higher latitudes when the cold abated, we must conclude that they had become adapted to the rigorous climate, an effect which could only be brought about by a very gradual lowering of temperature. This conclusion is strengthened by the presence at the same time of the mammoth or woolly elephant and the woolly rhinoceros, which have disappeared since man became an inhabitant of the European era. Though in their distribution the two branches of the herbivora overlap, the ruminants or younger branch occupies decidedly the coldest portion of the region over which the family is dispersed. In the distribution of the herbivora and omnivora, one of the oldest branches of the Ungulata, and in the distribution of mammals and reptiles already sketched, we find an exactly similar arrangement, the older types being more restricted than the newer in their latitudinal range.

From the remains of plants and animals preserved in sedimentary rocks we infer the climatic conditions of the Tertiary and earlier geological periods, but the evidences of the ice age are more direct. In the British Islands, in New Zealand, on the mountains of Southern Europe and on the slopes of the Himalayas, from end to end of the American continent, in every quarter of the globe, there are traces of ice action on an extensive scale where no ice now accumulates. We have no means of determining in years when the building up of moraines, the grooving, polishing and transporting of rocks took place, but we can say with certainty these widely scattered remains all belong to a very recent geological period. Many animals that inhabited the Eurasian region during the ice age still exist, while others have become extinct, the most important being the reindeer and mammoth, both of which were contemporaneous with primitive man. Of all the large herbivorous mammals, the reindeer occupies the most dreary regions, subsisting on the scant vegetation of Greenland and the shores of the Arctic Ocean. Like its survivor the reindeer, the mammoth occupied the coldest portion of the northern hemisphere. The discovery of complete carcasses in the tundra of Siberia has familiarized us with the physical features, the habits and food of this unwieldy monster. After quoting in full a description given by M. Benkendorf, a Russian surveyor, who in 1846 had an opportunity of examining the carcass of a mammoth in the bed of the Indigirka, Mr. Boyd Dawkins in an article on the range of the mammoth continues: "This most graphic account affords a key for the solution of several problems hitherto unknown. It is clear that

the animal must have been buried where it died, and that it was not transported from any place further up stream to the south, where the climate is comparatively temperate. The presence of fir in the stomach proves that it fed on the vegetation which is now found at the northern part of the woods as they join the low, desolate, treeless, moss-covered tundra in which the body lay buried—a fact that would necessarily involve the conclusion that the climate of Siberia in those ancient days differed but slightly from that of the present time."

During the ice age the reindeer and mammoth ranged as far south as Italy and the shores of the Caspian; associated with these were the northern glutton, the elk and the musk ox, still existing, but confined to high latitudes, and the cave bear, cave hyena, Rhinoceros hemitechus, that have passed away. There is nothing to indicate that previous to the glacial period this fauna was confined to a narrower or more northerly zone, or that during the Quaternary period there was any extraordinary change in the fauna of Eurasia, all the Quaternary mammals having their prototypes in animals that inhabited the region in the preceding periods.

From the warm covering of the reindeer and its moving southward in winter and returning to its northerly haunts in summer we may conclude that it essentially belongs to extremely cold climes and is not adapted for a warmer zone. The extinction of the reindeer south of the Baltic within historic times proves it was not as capable of maintaining itself as were the other species of hervas still inhabiting Northern Germany.

We learn from M. Benkendorf that unlike its almost naked relative Elephas Indicus the mammoth was clothed with a dense covering of hair and wool, plainly an adaptation to its inhospitable habitat; possibly it may have been migratory, which would account for its remains being discovered so far south. We know that the early inhabitants of Europe were acquainted with the mammoth and that they employed its tusks in their primitive arts. From this and the fact that its huge body being unfitted for concealment it has been concluded that the species was exterminated by man, but we may ask why were not the elephants that survive also exterminated? They are likewise bulky animals not very capable of concealment.

Knowing that the animals of the polar regions cannot be transplanted even into the warm portions of the temperate zone any more than the animals of the tropics can be transplanted to high latitudes, it seems more reasonable that the extinction of the mammoth and its numerous contemporaries was owing to their being constitutionally unfitted for a warm climate. The length of time that has elapsed since the disappearance of the glacial ice is not very great; its climatic change must therefore have been comparatively rapid, probably too rapid for the slow process of adaptation.

In the present Arctic and Sub-Arctic faunas we see the glacial fauna impoverished by the disappearance of many large characteristic species and with its domain reduced to a mere fragment of what it was originally. This is precisely what befell the reptilian fauna of Mesozoic times; its largest and most conspicuous members were eliminated and its domain curtailed; but while the glacial animals were drawn toward the poles, reptiles were driven toward the equator. Regarding the Arctic animals, we can say positively the disturbing cause was climatic; the abatement of the glacial cold compelled them to retreat northward, abandoning places where their remains are now found. In the case of the reptilia, the effect being so similar, we may reasonably conclude the disturbing cause was also climatic, but of a different nature. It is from cold regions reptiles have disappeared; to a cooling of the ocean and atmosphere the dying out of so many species and their limitation of range must be attributed.

The early Quaternary animals of Eurasia being so well adapted to the rigorous climate of the ice age, besides proving that the change of temperature was very gradual, shows that the species were capable of adaptation or variation in that particular direction. Throughout the Tertiary period the European mammalia underwent continuous modifications. The arborescent animals, the great omnivora and the tapir-like ungulate of Eocene times, gave place to animals better adapted for open country, to ruminants of the type which were ultimately displaced by modern forms. The only favorable explanation of these modifications is they were adaptations to changing conditions. To climatic alteration, to a general lowering of temperature, the displacement of the cold-blooded reptiles by warm-blooded mammals, which commenced in the Mesozoic period, is due; but this change did not cease when mammals came to the front. Like their reptilian predecessors, the European mammals of the early Tertiary epoch retired toward the equator and disappeared.

We cannot follow any slow change step by step through the geological record; a variation must be well pronounced before it can be recognized with certainty. All geologists agree that the climate of Europe was colder toward the close of the Pliocene period than it was during the preceding Miocene period. The evidences of the ice age are unmistakable; and the age of reptiles, its passing away, and the great changes that have taken place in the European mammals are distinctly recorded. From this evidence taken as a whole, and interpreting the past by the present, the only feasible reply to what was the ice age seems, that from the Mesozoic period onward there was a gradual cooling which culminated in the glacial cold and which was followed by an increase of temperature.

The causes of these climatic changes are not within the scope of this inquiry, but if the conclusions arrived at are correct they must at once account for the high temperatures of the ocean and atmosphere in the early geologic times, for the gradual coming on of the glacial cold and for the return of a more genial climate.

RISK OF DISEASE FROM GARBAGE GATHERING.

THE Philadelphia Medical Journal says: "In all of our hygienic concern and progress it seems strange that, the world over, there is such great carelessness in the gathering and disposal of the refuse of city houses.