storm's center; and this cause may operate with sufficient force to carry the storm's center westward, as actually happened in several instances in the years 1872 and 1873. On the other hand, an increase in the velocity of the wind in the eastern quadrant tends to produce a greater precipitation on the eastern side of the storm's center: that is, tends to push the storm's center eastward, or increase the velocity of its progress.

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Contents:

(Illustrated articles are marked with an asterisk.)

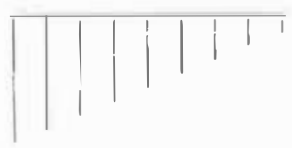
THE SIMULTANEOUS PERCEPTION OF SOUNDS.

The celebrated German physicist Helmholtz has, in his *Physiological Theory of Music*, made some modifications in various points of the hypothesis by which he accounts for the functions of our organs of hearing.

It will be remembered that, in the process of hearing, the sound waves of the air are collected by the outer ear which is peculiarly adapted by its form to concentrate them. The waves then pass along a canal to the tympanum or drum, which they vibrate. This vibration is communicated by a chain of bones to the membrane covering the *foramen ovale*, by which it is passed to the fluid contents of the inner ear and thus reaches the nervous surface which transmits to the brain the sensation of sound. It is not difficult to understand how the liquid in the inner cavities may be thrown into vibrations of which the durations are the same as those in the outer air, while the amplitudes are proportional, if acted upon by sound waves coming from a single source. But when we consider that the vibrations of so small a quantity of air as that contained in the auditory canal, transmitted to the still smaller surface of the inner ear, suffice to convey a perfect perception of the most complicated exterior phenomena, then the mystery begins. During the passing by of a military band, for example, we hear not only sounds emitted by the instruments, but the rolling of carriages, the voices of the crowds, the rustling of the leaves of trees, and innumerable other noises, all clearly distinguishable.

The eye, it is true, can regard an extended view or a multiplicity of subjects, but its perception is successive; it glances quickly from point to point and thus embraces all, but the ear recognizes a number of sounds simultaneously.

To understand the theory by which Professor Helmholtz explains the phenomenon, it is necessary to consider the oscillations of a pendulum. It is well known that a suspended body, even if of considerable weight, may be set in motion, by slight successive impulses, provided the latter be properly timed. These impulses must be repeated at equal intervals, and, in the case of a pendulum, act in the same direction as the movement of the body, determined by gravity, which is the motor force. Otherwise their effect will be to stop the motion rather than to accelerate it. Hence the interval of time which separates two consecutive impulses must be equal to the duration of an oscillation of the pendulum or to a multiple of such duration. Suppose a number of pendulums of different lengths be arranged in regular succession in the same vertical plane, as shown in the accompanying diagram. With a rigid horizontal rod, imagine the experimenter to strike all these pendulums in some particular rhythm. It is evident that such pendulums of which the times of vibration are



equal to the interval between two successive blows, or to a submultiple of such interval, will oscillate. To all others the cadence of the rod will be in opposition, and they will hence stop and remain at rest. The same result takes place if sonorous cords, each having its own duration of oscillation, be substituted for the pendulums. Suppose that in the internal ear a great number of nervous fibers exist, the movements of which correspond to a determinate impression for each one. If the liquid vibrates during a certain period all the fibers having a corresponding time of oscillation will be set in motion; and a combination of impressions will result, peculiar to a given vibration, and different for any other. Such in brief is the theory by which Helmholtz explains the perception of simultaneous sounds, harmonies, the production of beats, and in fact all the phenomena due to audition. The probability of the truth of this view is strengthened by the fact that the internal ear does contain a great number of organs which appear to be suitably disposed in order to serve as vibrating fibers. In the first edition of his work, Helmholtz believed that the nerve prolongations, known as the organs of Corti, fulfilled the purpose, but in subsequent editions he has renounced this idea, since Hasse has proved that the Corti fibers do not exist in amphibious animals. Among the membranes, however, in the interior of the inner ear, is one known as the basilar, which is ruptured with difficulty in a direction longitudinal to its fibers, while it yields readily to force applied in a perpendicular direction to the same. Helmholtz now considers the fibers of this membrane to act as a series of juxtaposed cords, and the variation in the length of the fibers (since Hensen has proved that the breadth of the membrane increases from one extremity to the other in proportion of one to twelve) tends to confirm the hypothesis.

M. G. Guérolt, the French translator of Helmholtz' work, suggests that the Corti fibers may serve the purpose of dampers, but adduces no experiments or other proof in support of the idea. An exhaustive comparative examination of the auditory mechanism in various animals, by means of the microscope, would doubtless show which organs are everywhere necessary to audition. Besides, as there appears to be a relation between the auditory faculties and the pitch of the voice of animals, the detailed comparison of the ears of those having deep voices with the similar organs of others having voices of a high pitch would probably elicit curious and valuable results.

THE AQUARIUM.

One of the first principles, in constructing a tank for an aquarium, is to give the water the greatest possible exposure to the air. The simple rectangular form is the best. This is generally constructed of iron and glass; the iron should be japanned, and the glass be French plate, to insure brilliancy and strength. The breadth and hight of the tank should be about one half of the length. Cheap tanks can be made of wood and glass, the frame and bottom being of wood, and the sides of glass. In order to make the joints watertight, care must be taken to get a proper aquarium putty or cement. The following is a good recipe: Put an eggcupful oil and 4 ozs. tar to 1 lb. resin; melt over a gentle fire. Test it to see if it has the proper consistency when cooled; if it has not, heat longer or add more resin and tar. Pour the cement into the angles in a heated state, but not boiling hot, as it would crack the glass. The cement will be firm in a few minutes. Then tip the aquarium in a different position, and treat a second angle likewise, and so on. The cement does not poison the water. It is not advisable to make the aquarium of great depth; about eight inches of water is sufficient. In regard to the light, great care must be taken. Too much often causes blindness, and is a common source of disease. The light fish receive in rivers comes from above; and an aquarium should be constructed so as to form no exception to this rule. All cross lights should be carefully avoided, at least if the light is very strong. Never place the aquarium in front of a window so that the light passes through it; for, when viewing an aquarium, the source of light should come from behind us. Not enough light is as injurious as too much, and causes decay of the vegetation. Having constructed a watertight aquarium, the bottom is strewn over with clean sand to the depth of 1 to 3 inches, on this a little gravel is spread; then a few stones or rockwork. Heavy large rocks should be avoided; they displace a large amount of water and increase the danger of breaking the glass sides. Pumicestone, well washed, is the best kind, being light and with a rough surface suitable for the rooting of plants, etc.; and if fancy forms are desired (bridge work, etc.), the pumicestone can be cut quite easily to the desired shapes. The plants are rooted in the sand and the vessel left at rest for a week for the plants to vegetate. The following plants will be found useful: *Utricularia inflata, utricularia vulgaris, myriophyllum spicatum, anarcharis Canadensis*, and *hottonia inflata*.

In obtaining plants, procure all the roots and see that they are well rooted. If fungus should form, add snails (*planorbis trivolvis*); they will completely destroy it. After the plants are well started, add the shells and amphibious animals. The following shells will be found desirable: *Planorbis trivolvis, physa heterostrapha, unio complanatus.* Many shells are not needed. Snails act the part of scavengers; and where the different elements of an aquarium are rightly balanced, two or more snails will be found sufficient.

If amphibious animals are introduced, the rock work must extend above the surface of the water, or a float of some kind must be substituted. It is impossible for them to live under water all the time, and they would die without some such arrangement.

The turtles claim first rank. The *enys punctata*, or spotted water turtle, and the *chrysemys picta*, or painted water turtle, will be found to be the best for the aquarium, and should be procured when very young, as they are very destructive when old. The tritons (*triton tigrinus, triton niger*), the red salamander, the cray fish (*astacus Bartoni*), are all suitable, and present a very odd and yet a very natural look to the aquarium.

In selecting the fishes, there is no boundary to the number to be obtained, but experience has proved that comparatively a few only thrive in confinement. Among these, and the first, is the gold fish. He can live for months without introduced food, and is, without comparison, the most hardy, standing remarkable changes in the temperature; and he is the most gaudy and attractive. A large number of the fishes prey upon each other, and will only do for the aquarium when in the young state. Among these may be mentioned *pomotis vulgaris*, or sun fish, *esox reticulatus*, or common pickerel, and *perca florescens*, or yellow perch. The *leucis cus pygmæus*, or rock fish, is a great addition, and is found very plentifully in our streams. The *pimelodus atrarius*, or common black catfish, is another worthy of a place. So also is the *hydrargia diaphana*, or transparent minnow. But few fish can live in an aquarium; and the needless crowding together, so often seen, is very hurtful to health, and causes sound, strong fish in a short time to become weak and poor. The great difficulty in keeping an aquarium is to secure enough oxygen for the fish. To a slight degree, it is the duty of the plants to supply this; but if too much vegetation be present, decomposition takes place and ruin follows. It has been demonstrated that only a small amount is necessary to absorb the carbonic acid given off by the fish and amphibians; consequently, if the water be daily aerated with a syringe, it will absorb an abundant supply of oxygen for the animal life, and the trouble arising from the decay of much vegetable matter will be lessened or altogether avoided.

THE PRACTICAL MAN.

He sat beside us in a street car. He looked over our shoulder at the new copy of the SCIENTIFIC AMERICAN, which, fresh from the press, was receiving our final scrutiny, and requested the loan of the paper for a moment when we had finished. He glanced at the first page, skimmed over the middle, and peeped into the inside.

"I suppose that paper interests a great many people," he remarked.

We modestly signified our assent, and murmured something about forty odd thousand.

"Wa'll, it does'nt me," he interrupted sharply. "I does'nt take no books or papers to learn me my business, you know. Never learnednuthin from books in my life. Did'nt have but a quarter's schoolin, and then I went into the shop. Served my time with old Pete Reynolds, of Boston. You know'd him, mebbe; dead now. Was his foreman; now I'm boss of my own works in the city. I'm a practical man, I am. All yer hollergeys and hosserphys may do well enough to write about; but they ain't no sort'er use in the shop. They just git inter mens' heads, and set'em a thinkin about other things than their work, and then they git inventin', and that's the last of 'em. Why, I had a likely young feller, who used ter buy that paper, and read on it, dinner hour. Sometimes he'd stick it up on his lathe, until I stopped that, mighty sudden. Wall, one day I caught him scribblin' with a piece of chalk on a bit of board; then I know'd the invention fit had got hold of him, and that he was a goner. A few weeks after he comes to the office, and says he: 'Boss, I've got a little arrangement here that'll make the old lathe do better work,' and he out with one of them reg'lar printed paytents, and showed me a new attachment for making gearins, and sich. 'Wall,' says I, to humor him, like, 'sonny,' says I, 'you can go make yer masheen and set it up on the lathe, if yer wanter.' But the ungrateful villin began to say something about royalty and shop rights, and I told the book-keeper to pay him right off and let him clear out. Blow me if he did'nt go over to Smith's, acrost the street, and rig his affair there; and the first thing I know'd, Smith was turnin' out work at half my prices. Then I had to go find that feller, and pay him his blamed royalty, and a heap it was too.

"Now, there was a good hand just spiled by a-readin'; if he'd a let that ere paper of your'n alone, he might ha' been a good, stiddy man, gittin his three dollars a day comfortable and reg'lar. Now they say he's makin stamps by thousands, but he's spiled. Wont be worth nuthin ever fer work agin. Where'ud I have been if I'd pegged away at books and noozepapers—eh?"

Our practical friend did not wait for an answer; for while we were cogitating a suitable response, he suddenly made a bolt out of the car and rushed down a side street toward a dilapidated looking edifice, which, we conjectured, was none other than the "works."

"We want no theorist, we require a practical man." "Where can I find a practical man to take hold of my invention and push it?" How frequently we have heard these remarks! And how often, when we have turned to the speaker and asked for a definition of the term practical man, has a puzzled expression and a lame attempt at explanation, usually ending with "Oh, I know what I mean," been the sole reply!

Our street car friend is one type of the practical man. He is of the "self-styled" variety, the most numerous, probably, existing. He is the least useful as an individual, the least progressive as a brain worker, and the least enlightened as a member of the human race, of any class of civilized mankind. He is a compendium of thumb rules, an epitome of set ideas encircled by the iron barriers of his own mind, which allow of neither the substitution nor admission of better views, nor the expansion of those within. At mere handicraft, he may be skilled; but ask him for a reason, and he is dumb. He it is who leads the van of the shriekers against free and liberal education, who clings to that sophism which argues that the "world is the best teacher;" who turns his son directly from the nursery into the shop; who renounces the inventor and all his works, until compelled, by absolute force of circumstances, to yield to progress: and finally, who, having no knowledge other than his manual skill and set of thumb rules, scorns it in others.

"But we want no longhaired philosophers to run our shops," possibly thinks the reader. True, nor need we have them. "Science," says Lord Brougham in his fine definition of the term, "is knowledge reduced to system." The true scientist is he who not only possesses this systematic knowledge, but, if he be so situated as to require its immediate aid, knows how to put it in practice. He is neither the sage who meditates erudite abstractions, nor the *soi-disant* "practical man" who devotes himself to mere system. He is eminently the man of practice, but of intelligent practice, who is a master of principles, of reasons: to whom the mere application of a truth is nothing as compared with the truth itself: the latter immutable, the former an idea to be changed as occasion may require or judgment suggest. Such is the person we mean when we seek the "practical man," not the blatant individual who thrusts himself forward under that title.

Our acquaintance of the street car carried off our paper. He honestly mailed it back to us the other day. We smiled as we saw the thumb marks on all the pages, and opposite an engraving there was a pencil note of: "I kno a bettur plan than this." Perhaps after all a latent idea in his brain has been aroused; or has he taken the invention fit? Should he see this, he will probably scout the idea that our humble efforts have awakened him, for "it does'nt take no papers to learn me my business, you know."

LANGUAGE OF INSECTS AND ANIMALS.

Our notice was lately attracted to the labors of a colony of small black ants, which has taken up its abode in a chink in the wall outside our office window. A solitary ant, evidently on a private foraging expedition, suddenly encountered a scrap of bread, which had fallen on the sill several feet from his home. Instead of nipping off a fragment and carrying it away, the insect apparently made a careful examination of the entire piece and then turned and ran at full speed back to the hole. In an instant hundreds of ants emerged and marched directly to the bread, which they attacked, and very speedily, morsel by morsel, transported it to their dwelling.

Another good instance is that of a terrier dog belonging to a friend, from whom we obtained the facts. The animal somehow, it seems, excited the ire of a larger dog, and accordingly received an unmerciful shaking. Shortly afterward the terrier was seen in close consultation with a huge Newfoundland. The result was that both trotted off together, and found the terrier's assailant, which then and there received a furious thrashing from the Newfoundland, while the terrier stood by and wagged his tail in high glee.

The last case which came under our own observation was that of a brood of very young chickens which, losing their parent, refused to go with another hen but manifested an extraordinary affection for a pair of turkeys almost as juvenile as themselves. The turkeys have assumed all the parental functions, scratching worms for their charges, and gathering them under their wings, while the chickens appear to comprehend the significance of the turkeys' "peep" equally as well as they did the clucking of their natural mother.

In the case of the ants, it is clear that the single insect must have imparted the news of his discovery to an entire community of his fellows; in that of the dogs, the terrier must have made the Newfoundland understand the circumstances of his misfortune and so secured sympathy and assistance; lastly, between the chickens and turkeys, apart from the singularity of the relation, it is curious to remark that the language of one fowl was understood by others of different species.

DEAD CITIES.

To Americans especially the ancient world is little more than an abstraction. Save the relics of the mound builders which dot the prairies of the West, and the occasional discovery of old Indian remains buried here and there in New England, we have little to bring us face to face with evidences of human existence in ages gone by. We study our histories and become familiar with them as we are with the tale of the romancer: we can discuss the Punic wars with as much freedom, perhaps more, than the closing campaigns of the Rebellion: but the new world, except in its sparsely filled museums, shows us nothing tangible, nothing which we can directly connect as part and parcel of the times and men of historic yore.

But let the old world be visited, and the antiquarian may find the very handiwork of nations which have utterly disappeared. Whether he wander through civilized Europe, half civilized Asia, or barbarous Africa, everywhere are relics of the past, all forming, to the lover of archæology, a feast, never so rich as at the present day. He may ramble through Spain, and muse over the quaint architecture of Moors, recalling the heroic prowess of the Cid; he may climb that hill jutting into the harbor of Cartagena, and stand in a building reared by the army of Hannibal. He may trace out the Roman camps in Northern England, or the earlier relics of the Druids and Norsemen, or he may roam for hours through the streets of Pompeii, reading the history of everyday life seventeen centuries ago in the marks of the wheels on the pavements, the signs on the stores, or the very bread lying, black and dry, in the ovens. He may watch the laborers as they slowly dig out the loose ashes in a buried room, and will see them stop their work when the floor is almost reached. Then, as we did ourselves one warm summer morning not many years ago, he will see the men carefully grope through the residuum. A shout denotes a discovery, and then very carefully a bar is pushed down into the place where the object is supposed to be. Into the hole thus made, the liquid plaster is poured. A few moments of anxious, curious delay and the spot is again attacked, the ashes thrown quickly upward, and the plaster, now set and hard, withdrawn. Perchance the mold of some household object is produced; sometimes it is a human figure, such as we saw unearthed, which, with its arms doubled over its head, had crouched into a corner for shelter, but only to die there, suffocated in the deadly shower.

Then there are the Syracusan ruins, little visited by the tourist, but overflowing with interest. He may wander past the very walls, cross perhaps the threshold over which Archimedes stepped while pondering the problem, of which when solved, he shouted *Eureka!* (I have it), and rushed naked, through the streets. On some seat of the amphitheater, which he enters, the great inventor may have reclined while devising his burning glass, his levers, and the engines of war with which he routed a besieging enemy. On descending the huge caves hewn from the solid rock, he may marvel at the knowledge of acoustics which dictated to the tyrant Dionysius the building of that labyrinthine passage which so closely counterfeits the duct in the human ear. Clambering up the rough hewn steps, the little closet is before him where the cruel king used to sit and hear the slightest whisper of his captives in the vaults below. The tearing of a scrap of paper sounds there like the rushing of a vast wind, and a pistol report is deafening. Hard by is the circus made famous by the story of the slave Androcles, whom the lion refused to attack because his antagonist had before removed a thorn from a wounded paw. There also is one of the earliest of Christian churches, erst a heathen temple, in the crypt of which are still to be seen the gridiron, the pincers, and the other instruments of torment by which perished the early martyrs of the Church.

The subject is a fascinating one, and, as we write, it looms up before us to such magnitude that the traditional "acres of paper and oceans of ink" would barely suffice to do it justice. But the confines of newspaper space are inexorable. Therefore, with this brief glimpse of the romance of archæology, we refer the reader to the latest news from the subterranean world, which he will find in the record, of the excavations and explorations now or lately in progress, printed on another page.

SCIENTIFIC AND PRACTICAL INFORMATION.

STRASBOURG GOOSE CULTURE.

Pâte de foie gras, or Strasbourg pie, is an oleaginous luxury, very expensive in this country, and about as indigestible as it is costly. As its name indicates, it is a pie filled with the livers of geese, which are rendered, by peculiar treatment, diseased, and hence abnormally enlarged. To produce the necessary development, the fowls are closely confined by tying, for a period of seven weeks, in dark cellars, during which time they are fed with a paste of maize, chestnuts, and buckwheat. This is stuffed down the throat once in two hours, and the effect is at last to produce an enormous enlargement of the liver, when the fowls are killed, and the livers used as above mentioned.

PULVERIZING THE CHLORATES.

Chlorate of potash and other chlorates are extensively employed in the manufacture of fireworks. The inconvenience, of moistening with alcohol before pulverizing them, and pulverizing wet, may be overcome by employing the following method of Gawalovski: The salt is dissolved in hot water until a perfectly saturated solution; is obtained, when a pane of glass is dipped into the solution; and on taking it out, it is found covered with a layer of fine crystals of the salt. They are scraped off with a paper card on to a sheet of paper, and form a kind of meal. This method is entirely free from danger to the workmen, and a large quantity of the salt is readily prepared in a relatively short time and with very little inconvenience.

ACTION OF SULPHUR PREPARATIONS IN CHRONIC LEAD POISONING.

By the advice of Dr. Liebreich, M. Siew has attempted to chemically combine the lead distributed through the organism, so as to render it harmless. To satisfy himself of the possibility of doing this, he injected subcutaneously some chromate of lead; and after introducing suitable sulphur compounds, he tested for sulphide of lead at those points. If alkaline sulphides were administered, the red color of the injected tissue remained unchanged; but if a rabbit partook of glycosulphuric acid, which is easily soluble in water, and forms with lead a very insoluble salt which passes off unchanged from the system, then the injected part showed a black spot. Siew considers this to be sulphide of lead, from the reduction of the glycosulphate of lead. That this salt is really reduced by the organism is proved by feeding animals a long time on glycosulphate of lead, when the walls of the stomach are found to be black. He does not state his conclusions.

LIME DEPOSITS IN WATER PIPES.

MM. Fabre and Roche point out that wherever there is a joint in water pipes, made to connect tin conduits or copper faucets, at such points carbonate of lime is most abundantly deposited. If a piece of silver be placed inside in contact with the lead pipe, it becomes covered with the carbonate in a very short time. The investigators find that all metals, electro-negative with relation to lead, are thus affected. A voltaic couple is in fact formed, and a veritable chemical precipitation caused.

TESTING URINE FOR ALBUMEN AND SUGAR.

The following tests by Siebold are so simple that an inexperienced person can employ them for testing urine: In testing for albumen, ammonia is added to the urine until it is slightly alkaline; it is then filtered, made slightly acid with dilute acetic acid, and a portion of the mixture boiled. This portion is compared with the cold portion, when any turbidity is easily detected. In testing for sugar, he employs a modification of Roberts' process, whereby an inexperienced analyst can detect $\frac{1}{2}\frac{1}{0}$ per cent of sugar, while a more experienced person can easily recognize half that quantity. About one and a half or two fluid drachms of Fehling's solution is heated to boiling, and five to ten drops of the urine added. If much sugar be present, a yellow or brick red precipitate is formed. If this does not happen, add 50 or 80 minims more of urine, and set aside to cool. If the liquid is not milky when cold, less than $\frac{1}{4}\frac{1}{0}$ per cent sugar is present.

ANOTHER NILE EXPLORING EXPEDITION.

An expedition is being organized in Egypt for the purpose of examining the geological and physical constitution of the valley of the Nile, and of the land bordering on the Red Sea. The most important question to be determined is the possibility of establishing a branch of the river in the ancient bed of a stream occupying the base, or the valley called by the Arabs the Valley of the Dry River. If this work can be accomplished, a large amount of now waste land will be rendered suitable for agriculture.

NON-INFLAMMABLE SHIPS.

The British Admiralty have lately caused some experiments to be conducted at Plymouth, England, upon wood saturated with a solution of tungstate of soda. These, we understand, have given successful results, sufficient to warrant the construction of two small vessels, one made of ordinary timber and the other of the same material treated with the chemical. Both, when completed, will be filled with combustibles and fired simultaneously, thus submitting the efficacy of the protective substance to a final and crucial test.

PRIMEVAL MUSICIANS.

Another curious relic of primeval man has been discovered, which shows that our very remote ancestors, in addition to being cognizant of the arts of sculpture, drawing, and engraving, were also, in their rude way, musicians. M. Piette has recently found, in a cavern in Dourdon, France, mingled with scraps of pottery, bones of animals, and flint implements, a flute. The instrument is made of bone, and has but two holes, so that it could produce but four sounds. It bears a close resemblance to the similar instruments used by the savages of Oceanica.

DANGER IN BAD FLOUR.

From an investigation, recently conducted in Petersburgh Michigan, into the cause of the epidemic of cerebro spina meningitis, with which the locality has been afflicted during the past spring, there appears ground for ascribing the prevalence of the disease to some poisons in the food of the people. Experiments conducted many years ago showed that grain affected with smut was capable of producing violent illness. Ergot of wheat is more active even than ergot of rye. The examining physician, in the present case, reports that the crop of the first mentioned grain, raised in the vicinity last year, contained much more smut than usual. It is, therefore, possible that the disease is due to consumption of bad flour.

ARSENICAL WALL PAPER.

Some new cases are reported, by the Michigan State Board of Health, of severe illness caused by living in rooms papered with green hangings. Two instances are mentioned of families becoming sick; and on the paper being examined, 1·16 grains of arsenic to a square foot of surface were found.

ORNAMENTING METAL SURFACES.

A NEW process for ornamenting metal surfaces, by K. Goddard, of Richmond, N. Y., consists in plating, electroplating, or otherwise covering a plate, bar, or ingot of soft metal with a thin film of harder metal, and then rolling out or pressing the ingot into a sheet; whereby the coating is broken into irregular forms, and a marbleized appearance produced on the surface of the sheet