at the feet of Alexander after the Battle of Issus." Again we have these pointed waists and enormously distended skirts, which are certainly incompatible with an event which occurred in the year 333 B. C. The artist was a Venetian, and he drew the Venetian costumes of his own period, 1528-88. In many pictures depicting events closely associated with the foundation of Christianity we find figures introduced clothed in armor. This would not be of itself an anachronism, for we are told that Goliath in his combat with David was armed with "a coat of mail," which probably consisted of plates of brass attached to leather. But in the pictures referred to the armor is often the beautifully damascened suit of steel which did not come into vogue until the fifteenth century. We might also take exception to the figures of monks which are often introduced into the same pictures, for the monastic system was unknown in Rome itself until about the fourth century. The artists painted from what they saw around them, regardless of time and place, and they had no opportunities of taking any other course, and we may take it as certain that when in doubt upon any particular point they would seek advice from the dignitaries of the Church for whom so much of their work was done. Raphael, like so many others, drew his Madonnas, his saints, and his martyrs from Italian models, and clothed them in contemporary Italian costume, giving the figures as a background the scenery with which he was so familiar. It was only when travelers came to visit the Holy Land and saw the people there, unchanged in sentiment, habit, and customs for centuries, that a few came to realize that the pictures were wrong.

And there was no other way, so far as that country was concerned, of getting at the true facts except by travel. For the Jews, in their hatred of everything in the shape of a graven image, had preserved no pictorial records of the past. The artist was thrown back upon his imagination, aided by visual impressions of his own surroundings, and his pictures were untrue to fact. Persons and things were treated in a conventional manner, and the stereotyped forms were repeated again and again as a recognized and accepted practice. It was not until facilities were provided for visiting the East and the cradle of Christianity that any one could say with authority that the conventional forms were wrong. It was impossible for even such a genius as Leonardo da Vinci to know that a table, a spotless tablecloth, plates, knives, and forks, and saltcellars were wrongly introduced into one of his most famous works, and that the Eastern people whom he painted used neither tables nor chairs, but squatted round and ate from one dish.

To come to more recent times, we shall find that anachronisms of costume and scenery were as common little more than a century ago in dramatic representations as they were in pictures. We have in our possession some old copperplate engravings which give certain evidence of this. We need only refer to one here, which has for its title "Mrs. Hartley in the Character of Cleopatra." She is dressed in a hooped petticoat, over which is a pannier skirt and a long train, the skirt being adorned with festoons of roses. Her waist is confined in the stiffest of corsets, while she wears on her head an earl's coronet surmounted by an ostrich plume. It would require the pencil of a Leech or a Phil May adequately to express Antony's surprise when he saw his Cleopatra arrayed in such fantastic style.

And it would not be the first time that a picture had been caricatured by reason of some incongruous feature. For instance, there is a well-known picture of Napoleon crossing the Alps. This subject has been quite a favorite theme with artists; but the particular example referred to shows the Emperor in gorgeous uniform mounted upon a richly caparisoned steed, which is prancing with delight at the august burden which it is honored by carrying. Such is the romantic idea of the event as it was presented to the mind of the imaginative painter. The caricaturist has given us a far more prosaic representation of Napoleon's famous journey. It is snowing hard, and the Emperor, so closely wrapped in his cloak as to look like a mere bundle of rags, is crouched up on the back of a wretched mule. A tall chasseur, as lean as the poor mule, grasps the animal by the tail with one hand and flogs it with the other. The caricature is probably far more historically correct than the more serious work.

Happily, it is getting more difficult every day for an artist to fall into error, for a much slighter fault than any of those cited is at once detected, and the detector is generally so proud of his acumen in noticing the slip that he at once gives it "bold advertisement." It is good for art generally that this should be the case, just as it is profitable for us all to have our faults pointed out to us.

THE EMISSION OF N-RAYS BY ODOROUS SUBSTANCES AND THE ACTION OF N-RAYS ON THE OLFACTORY AND OTHER SENSES.*

THE N-rays exercise a definite action on olfactive sensitiveness. This becomes apparent by bringing near the nose during olfaction any object capable of supplying these rays, such as a piece of tempered steel or of compressed wood, or the fist. The test should be made with the precautions requisite in such cases, in still air, very slowly, and with gentle and regular respiration, the odorous body being kept at a fixed distance, and more or less near the limit of sensitiveness, according to the case. The source of the N-rays may either excite sensation when the limit is nearly reached or may intensify the sensation when this has been produced. In either case the action is appreciable. It takes place when the radiating source is brought near the olfactory nerves or the base of the nostrils. If the muscular mass of the thumb is held against the *ala* of the nose, the slightest contraction of these muscles produces the effect indicated. A bar of steel held in wooden pincers is a convenient and effective source. The oil of cassia is a good substance for study. I have obtained the same results with various odors, the essential oils of lavender, thyme, and cloves, mint, camphor, ether, iodoform, ammonia, and acetic acid. The action traverses aluminium, and it is well, in order to avoid the currents of air due to the displacements of the source, to put a large plate of this metal against the front part of the nose, while operating on the other side of the plate. The N-rays may also influence olfaction when they are made to act on certain points of the nervous centers, as when the source is brought near the middle of the forehead, immediately above the *glabella*, the place of junction of the arches of the eyebrows, and especially when it is placed on the top of the cranium, a little in front of the *bregma*, the place of junction of the frontal and the two parietal bones. In the latter case the effect is striking. This effect of the N-rays does not bear exclusively on the perceptive organ. The olfactive sensation is augmented to a certain degree when the radiating source is brought near the flask containing the odorous substance, at a distance from the nose great enough not to influence it directly. On the other hand I have noticed that the preceding substances emitted the N-rays distinctly, that the rays pass through corks and aluminium plates, but are arrested by lead, and may give rise, like those of the other sources, to conduced radiations.

Respecting the action which the N-rays may exercise on the other senses, I have noticed a distinct influence in the sensation of taste. If a particle of a sapid substance, as camphor, aloes, salt, or sugar, is deposited on the point of the tongue, with the mouth open, the respiration suspended, and the palate raised to prevent all olfactive effect, the approach of such a source as a bar of tempered steel produces or increases the sensation of taste. The sensation is still further intensified by the N-rays, when, instead of localizing the sapid body on the point of the tongue, it is diffused through the mouth. There are points of the cranium on which the action of the rays may augment the gustatory sensation. After tests on different parts of the cranium, I have discovered this action of the rays only in a parietal zone near, perhaps a little anterior to, that in which there is action on the sense of sight.

The study of the sense of hearing is more difficult, on account of the precautions to take for preventing the displacements of the radiating source with reference to the ear from modifying by variable reflections the access of sound. Success is attained, however, by utilizing conduced radiations. On taking as a sonorous source a watch held at the limit of the perceptive distance, I have noticed distinctly an intensification of the sound only when the terminal plate was placed directly above the ear, seven or eight centimeters above the auditive orifice, which appears to accord with the idea of an excitation bearing on the cerebral centers of audition.

* From the French of M. Augustin Charpentier.

THE TEMPERATURE OF FLAMES.*

IF a flame contains a solid substance of known radiating power we can determine its temperature without putting an instrument into it. A luminous flame contains carbon in the solid state, and it is possible in such a case to measure the temperature of one part of the flame at least by means of instruments placed at a distance from the flame; but for what are commonly called non-luminous flames, such as the flame of the Bunsen burner, which contains no solid particles, it is necessary to introduce the temperature measuring instrument into the flame itself. It now becomes desirable to consider more closely what it is exactly that we mean when we speak of the temperature of a flame, and we must direct our attention for a moment to the shape and structure of flames.

If a gas is mixed with the amount of air necessary for its complete combustion before it issues from the burner, we shall have a flame of the type in which the burning process is going on through and through to the central cone of unburned gases. If, however, we burn gas in the more usual way, by allowing it to flow out into the atmosphere without previous mixture with air, or after admixture with only a portion of the air that it requires, we shall have a flame of a different character. In the first case, that is, where no air at all has previously been mixed with the gas, the flame will consist of a shell of combustion of no considerable thickness. In the second case, the flame will consist of two shells of combustion, one an inner cone in which combustion occurs so far as the amount of air admitted with the gas will reach; the second shell, an outer cone of combustion where the half-burned gas is burned fully in the outside air.

The professor proceeded to illustrate by an experiment how in the case of a flame of benzene vapor the structure of the flame is altered in accordance with the amount of air supplied to the vapor before it issues from the burner.

* Lecture by Prof. Arthur Smithells, B.Sc., F.R.S., before the Institution of Gas Engineers.

MEANING OF FLAME TEMPERATURE.

Now, what are we to understand when we speak of the temperatures of these different flames? If we speak of the temperature of a current of warm air, we usually think of a uniform condition prevailing throughout the stream, and we should measure the temperature and understand it in the same way as if we were measuring the temperature of a stream of water. But as a flame consists usually of thin shells of combustion, it is obvious that the distribution of temperature throughout the whole volume of the flame must be very different from that in a current of uniformly heated air. In the middle of a flame we may have a temperature not very greatly above that of the surrounding air; at the edges of the flame, a quarter of an inch away, we may have a temperature above the melting point of platinum. Again, if we consider a flame from bottom to top we have no reason to expect that the temperature will be uniform. To thrust any instrument like an ordinary glass thermometer into a flame would, obviously, be absurd, for only a very small fraction of the bulb might be in the hottest part of the flame, and the temperature we should measure would give us no sort of idea of the thermal effects we could really obtain, say, on a Welsbach mantle. The temperature of a flame, as a matter of fact, is usually taken to mean either the temperature of the burning parts, or, if no further qualification is made, it means the highest temperature which can be found anywhere in the flame; but, as I have before insisted, it is extremely important that when the expression "the temperature of a flame" is used there should be an exact specification of what is meant, a clear indication of what part of the flame is referred to, and a description of the method by which the measurement has been made.

Having regard, then, to the structure of flames and to the great variations of temperature that occur within very small distances, it would seem desirable to have a measuring instrument of the smallest possible dimensions. The smallest instrument we can make will be gross compared with molecular dimensions. When we recollect that a hundred thousand million molecules of hydrogen heaped together would form a speck hardly visible under our most powerful microscope, we shall realize that our smallest instrument will still give us an indication only of the average condition of a vast multitude of molecules.

CALORIFIC VALUE AND TEMPERATURE.

If we are asked what is the relation between the calorific value of a gas and the temperature of a flame which it will produce, we may reply that though in general the higher the calorific value the higher the temperature of the flame which it can be made to give, this is not necessarily always the case. If we have two specimens of gas of the same calorific value, but of very different chemical composition, we may have considerable differences in the amount of air which they require for complete combustion; and so, although the rates of supply of the gases may be the same, and the rate of oxidation be the same, the different amounts of atmospheric nitrogen brought into the flame will produce differences of volume of the flame and consequently differences in the temperatures of their external surfaces.

CONCLUSION.

In conclusion, I draw your attention to a table in which I have collected the various estimates that have been made of the highest temperature of a Bunsen flame of coal gas. Of course, the gas used has not been the same in the different cases, but the discrepancies are far beyond anything that could be accounted for by that fact. The cause is to be found in the various sources of error to which I have already alluded. I also may direct your attention to a table of maximum temperatures which has recently been given by Prof. Féry as the result of an ingenious, though, I venture to think, not entirely unexceptionable, method of measurement, based upon the reversal of the D line of sodium vapor in a flame when viewed against an electric filament of known and alterable temperature. These figures will give you an idea of the intensity of heat obtainable with gaseous fuel. I may add that M. Féry estimates the temperature of the electric arc to be 3,760 deg. C., and that of the sun to be 7,800 deg. C.

Maximum Temperature in Flame of Bunsen Burner using Coal Gas.

Date.		Deg. C.
1860	Bunsen and Kirchhoff	2,350
1877	Rosetti	1,360
1892	Rogers	1,230
1892	Lewes	1,630
1895	McCrae	1,725
1896	Waggener	1,770
1899	Berkenbusch	1,830
1902	White and Traver	1,780
1905	Féry	1,871

Maximum Flame Temperatures (Féry, 1904).

	Deg. C.	Deg. F.
Bunsen burner, gas fully aerated	1,871	3,400
Bunsen burner, insufficient air	1,112	3,114
Acetylene flame	2,548	4,618
Alcohol flame	1,705	3,101
Denayrouze Bunsen, alcohol and air	1,862	3,384
Denayrouze Bunsen, half each alcohol and petroleum spirit	2,053	3,727
Hydrogen, free flame in air	1,900	3,452
Oxy-coal gas blow-pipe flame	2,200	3,992
Oxyhydrogen blow-pipe flame	2,420	4,388