SELECTION OF A SUBJECT.—It is strange what a long time it takes before the beginner can learn to choose a subject that composes well. Details attract him too much, such as a splendidly rugged trunk, a beautiful group of flowers, a charming reflection, or a most rustic cottage, which one and all rivet his attention regardless of surroundings, and he is surprised when his sketch is done how poor and uninteresting it looks if put upon a wall or beside other and better compositions. We should always regard general grouping first, and special interest of detail later. An admirable way of doing this is to half close the eyes, which causes the general grouping of lines and light, shade and color, to become more easily visible on account of the attention not being drawn off by the detail. It is also a great assistance to put up the arm in front of the face, holding the part from the elbow to the wrist horizontally, and to move it up and down until you see where the subject had better be cut off for the bottom of the picture. Then the other hand may be moved along it vertically to see where the sides had better come.

Sometimes the subject seems a beautiful one, as a rich and splendid bit of heather in full bloom, with perhaps some cottages and fir trees at a little distance, rather on one side, and distant hills beyond. Yet we find it will not compose into an interesting picture, and we try in vain the moving of one arm up and down, and of one hand backward and forward. Suddenly a man and loaded donkey emerge from the cottage gate and come slanting across the picture toward us, a little child stopping at the door to see him off. Immediately a good composition appears, and we only have to copy that to secure our picture. However, most probably nothing appears at all, and then we have to put our man and donkey in from some other place, but till we have imagined him it is as well not to begin our sketch unless it is indeed a mere study of heather to be used on some future occasion. In such case it should be made as finished and careful as possible, so that in copying it we should approach as nearly as may be to working actually from nature. A study is then always done for a special purpose, of use, and ought not to be shown. You may do it to improve yourself in drawing a special thing, and may make many of them, but only show them to a master, or some one from whom it is desired to get information, and not for the purpose of giving pleasure to others, for in that you will certainly fail. A study may be produced for the purpose of using it afterward when painting a picture, but this is going beyond the function of this book to consider.

The French consider that a landscape is no picture unless there are *three planes* or parts—the first plane or foreground, the second plane or middle distance, the third plane or extreme distance. An endless variety may be given to the composition by varying the size and importance of the three planes, but they should always be there.

If the *third plane* is missing, a close and shut-in feeling is produced. A little peep of distance should be got in somehow or other, though if this cannot be done, a fine sky will sometimes act as a third plane.

If the *second plane* is not seen the effect is theatrical. Though in nature occasionally, as in mountain scenery, we may have a fine landscape without a visible second plane, we know and feel it must be there. This feeling cannot be put into a picture, but it can be suggested by an eagle or floating cloud.

If the *first plane* or foreground is omitted, all strength goes out of the picture.

Lastly, if *both* the second and the third planes are wanting, the sketch is neither landscape nor picture, it is only a study. And even in a mere study (to be used, perhaps, as a background for figures) there had best be some break or hole, some gap in a hedge, an open gate or a window in a wall, through which you can catch a glimpse of distance.

The advice of a celebrated picture dealer to a young landscape artist was: "Never paint a picture with a shut-in composition. People inside rooms like to have pictures which, when they look at them, they can imagine themselves seeing out of to something fresh and bright beyond."

To choose a *subject* well you should perpetually think of how it will *compose* in your sketch, either with or without the accessories of figures or strong effect. The most interesting sketches are those which depend upon effect or figures for their strength.

Figures play so important a part in composition that it is as well to consider them separately.—*Sketching from Nature.*

DETECTION OF ADULTERATIONS IN VOLATILE AND FIXED OILS BY MEANS OF ABBE'S REFRACTOMETER.*

By SAMUEL P. DUFFIELD, Ph.D., M.D.

PROF. ABBE, of Jena, brought before the Jena Society of Medicine and Natural Sciences, in 1879, an improvement upon all former refractometers. By means of Prof. Abbe's improvement the refractometer becomes of service in detection of optical quality of fluids and also of solids. By the original construction of this instrument the *total reflection* which a thin film of transparent substance shut in between two glass prisms shows is made available for discovering the exponent of refraction of light, as also to get data for calculating its dispersion. The advantages which this method has over the method of Wollaston lies in the fact that while his method only permitted the examination of fluid bodies by total reflection, Prof. Abbe's first refractometer contained a principle which was destined when more fully elucidated to solve the problem of also reaching with the same instrument the index of refraction of solids as well as of fluids. Kohlrausch had constructed an instrument called by him total reflectometer (Annalen d. Physik und Chemie, Neue Folge, Bd. IV., pg. 1), and this proved the stepping stone upon which Prof. Abbe rose to the construction of his improved instrument.

Before I describe the instrument allow me a few words as regards light itself—as it will be necessary for you to understand the working of the refractometer to know something about light. It is certainly a fact that the ancients had, according to our present knowledge, a very crude idea of light. The earliest theory,

which is now called the "corpuscular," originated with the disciples of Pythagoras, who taught vision is the result of particles or films emanating from the surfaces of visible bodies and entering the eye. This theory was met by the Platonists, that vision was due to the emanation of an influence from the eye itself. Both of these theories have fallen as valueless, the Pythagorean or corpuscular receiving its death blow from our own countryman Franklin, who showed that if the particles were material they would have weight, and if they had weight they would from their immense velocity inflict such blows upon the eye that its delicate structure would soon be injured and destroyed. There remained then but one course for philosophers to pursue, and that was to follow the line marked out by Huyghens and the celebrated mathematician Euler, both of whom held that light, like sound, was the result of *wave motion*.

Laplace, Malus, Biot, and Brewster supported Newton, and the theory of Pythagoras commonly known as corpuscular fought its way until it found its Waterloo in the labors of Thomas Young and Augustin Fresnel. These two eminent philosophers, while adducing whole classes of facts not explicable by the Newtonian theory, succeeded in establishing the most complete parallelism between the motion of light and the waves of sound.

FIG. 1.

The justification of a theory consists in its complete explanation of all the phenomena, and as all the phenomena of light admit of satisfactory mathematical explanation as regards double refraction and polarization, it has been called, after that of gravitation, the most comprehensive and happy of all the hypothetical generalizations of physical science.

On the other hand, the necessity of having to suppose an ether to transmit these waves of light has called from Rankine, of Glasgow, the view that possibly a force acting upon particles at a distance, and having opposite polarity, would more fully explain matters. Nevertheless the wave theory has been deepening its foundations and making them more secure, and, until we can find a better one, proved so mathematically, we must take it in explaining the working of the refractometer. The instrument and the principles of its working are shown in the several cuts. Fig. 1 will aid us in describing a ray of light.

Let W W represent a section of the reflecting medium. I I the incident ray. L R the refracted one. Let P L Q be the perpendicular to the reflecting surface. Passing through the point of incidence L, with any radius, L R, described from the center L, the circle R M P, from M and R, let fall the perpendiculars M N and R Q on P Q. M N will then represent the sine of angle of incidence, I L P, and R Q the sine of the angle of refraction, R Q L. M N ÷ R Q gives the index of refraction, which is the same for the same substance, whatever be the angle of refraction. In the diamond for instance M N is always $2\frac{1}{2}$ times as long as R Q. In water it is $1\frac{1}{2}$ times the length of R Q.

This is the instrument (see Fig. 2). It consists of a double prism and a telescope, and in the telescope are two prisms called amiesee prisms, which are intended to polarize the light. The numbers 1.3, 1.4, and 1.5 (see

FIG. 2.

Fig. 3), with decimals intervening, represent the indices of refraction on the sector, C. The drum, A (Fig. 2), is rotated until a perfectly colorless light is obtained. When you look through any volatile oil put into it between the two prisms, you will find the different colors of the rainbow, violet, indigo, blue, green, yellow, orange, red, in other words, the spectrum. You turn the thumb screw just above the drum, A, until you reach the point at which there is a dark shadow, but colorless on its edge. Inside there are crossing lines or filaments like those in a surveyor's

instrument, so that you can bring the shadow which falls by the refraction of the light up to the crossings of the square lines, as soon as you reach the point of cutting evenly across the square line, which is done by moving the prism by means of the sliding index, B (Fig. 3), on the sector, C. Moving the prism, we reach the point in which the shadow, caused by the prism, up through the telescope, runs across the four lines and cuts them evenly across. We call that the point of reading, and by turning the drum, A (see Fig. 2), around we render the field of view perfectly colorless, and you then read it. Then you turn the instrument upon its side and read the figures on the sector, C,

FIG. 3.

which gives you virtually the index of refraction. The old way was to get the angle at which the prism stood, and by calculating the angle of refraction you arrived at the result and reached what was called the index of refraction. Now Prof. Abbe has so arranged his instrument with the movable index, B, that we have the index given us without any calculation. The ray of light is bent in passing through the prism from its direct line in this way (see Fig. 1), L-R-Q, forming the angle of refraction. The angle of incidence is represented by M-N-L. The sign of the angle of incidence divided by the sign of the angle of refraction gives you the index of refraction. To make these calculations on paper would require from two to three hours, while with Abbe's instrument it is done instantly by the motion of the index attached to the prism. The sector reads from 1.330 to 1.650 index of refraction. Wollaston reached the same result in his method. He constructed an instrument with the sights, S, S (see Fig. 4), similar to those of a gun. He looked into the square prism, P, and another prism was placed back of it, the light striking in from (arrow). By moving index, G, back, sliding it upon A, B, the index ran along F, G, and as this was divided into 16 inches, he could read the inches and proportion, and that gave him the index of refraction. The lengths of the pieces, E, F, and D, E, are proportional to the refractive powers of the prism and of air. This was called a total refractometer. Prof. Abbe, by putting the oil of peppermint, tansy, wintergreen, sassafras, or any other volatile oil between the prisms in his instrument, reaches a result at once according to the principles laid down.

You will remember we had quite a discussion in this city on dementholized peppermint oil. There were certain samples of oil sold in this city through some men who are manufacturing peppermint candies, and the *Free Press* made the statement that a certain amount of dementholized oil had been sold. It was found that most of the oil had been used, and the gentleman who sold the oil, thinking all of it had been used, sued the *Free Press* for libel, claiming heavy damages. It became the duty of myself, and other experimentalists, to find out whether that was pure or impure oil; whether dementholized or not. Nothing but treatment by the polariscope and by the refractometer could detect it; of course you can detect dementholized oil by getting it below the freezing point, but to prove beyond doubt that it is not, the refractometer alone will give you the index of refraction of ordinary oil, and will reveal an oil that is adulterated with oil of camphor or anything else which has a different in-

FIG. 4.

dex of refraction. But the great difficulty with dementholized oil lies in this, that the refraction of the oil itself is almost equal to the refraction of the menthol, and we found it very difficult to find much change in the refraction of the oil after the menthol was taken out. It is only by distillation of the peppermint oil that we reach that point.

I give, side by side, the behavior of the impure dementholized peppermint oil and also a sample of A. M. Todd's pure oil, in the refractometer at ordinary temperature of 70° Fahr.

* Read before the Michigan State Pharmaceutical Association, at its meeting in Detroit, September, 1888.

Fractions.	Index Refractometer. Mean of Impure Oil.	Index of Refrac. Pure Oil.
1	1.46600	
2	1.46000	1.47000
3	1.46202	1.47220
4	1.46402	1.46305
5	1.46302	1.46255
6	1.46400	1.46305
7	1.46250	1.46355
8	1.46402	1.46505
9	1.46402	1.46550
10	1.46700	1.46600
11	1.46904	1.51405
12	Too dark.	Too dark for estimation.

You will notice the first distillation shows 1.466, while the first refraction of *pure* peppermint oil distilled was 1.470. Second refraction 1.460, and second refraction of pure oil 1.4722. The third is 1.46202, and the third of pure oil is 1.46305. Now, what makes the difference? There was a certain oil of camphor in the beginning, showing that the index of refraction in pure oil was entirely distinct from the index of oil that contained the oil of camphor. This was carried on until we reached the tenth fraction. The dementholized oil reached eleven fractions, while the pure oil reached only ten. We could not test it all, it was too dark. The way to use the refractometer is: Turn the thumb screw to the left to bring the ray perfectly colorless, then take the index of refraction, then turn it to the right and take the index of refraction, and then get the mean by adding these and dividing it by two, giving 1.46502 (see table below).

IMPURE OILS.
 35½ R., 1.46500
 36½ L., 1.46505
 2)2.93005
 1.46502 = mean.

The real difference then in the reading of the two is only 0.00002, which is very accurate. We have the mean of the impure oil carrying camphor 1.465, while the pure or double distilled oil is 1.462 or 1.463. It is not only of value in testing volatile oils, but also the fixed oils, for instance, linseed oil. Cottonseed oil and linseed oil mixed registers at 1.477, and 75 per cent. of cottonseed would be 1.474. The index of cottonseed oil is so much more than the index of linseed oil that I will defy any man to put cottonseed and linseed oil so together that I cannot detect them. There are instances where the refraction in lard oil is so much like butter that another treatment is necessary. Sometimes in the analysis of butter it becomes necessary to take the Reichart method.

SPECIFIC GRAVITY.
 Temp. C. 100°.

Lard.	Margarin.	Butter.	Butterine.
0.8605	0.8601	0.8598	0.8672

REFRACTOMETER.
 Temp. C. 20°.

Lard.	Margarin.	Butter.	Butterine.	Cottonseed Oil.
1.4690	1.4692	1.4652	1.4698	
		1.4650	1.4733	1.4748

You will notice that the index of refraction for butter varies quite plainly from the margarin and butterine, showing that a sharper dividing line can be drawn by means of the refractometer. But in order to be sure of having the right index of refraction, you must be careful to see that all moisture is evaporated and you are dealing only with the dehydrated fats or olein. As evidence of this I cite an experiment made with fresh butter which was placed upon the warm prism and as soon as melted the index of refraction was taken and it read only 1.459; a sample of oleomargarin was also taken and it read exactly the same. On heating them for 12 hours in a water-drying oven the results were entirely different. Where we have oils with refractive indices nearly alike, as for instance:

Cod liver oil.	1.4801
Linseed oil.	1.4820
	2)2.9621
50 per cent. of each	1.48105

Now we could be sure this mixture or an oil having the index of 1.48105 could not be pure cod liver oil, but at the same time we could be thrown into doubt as regards linseed oil, for it varies from 1.4820 to 1.4835, according to the temperature.

How beautiful is the idea that almost all adulterations will be shown by the ray of light as it comes to us from that glorious globe, 14,000,000 times larger than the one on which we stand. Those of us who realize that there is a Creator ready to exclaim: "Knowest thou the place where light dwelleth, that thou shouldst take it to its bound or understand the path to its house?"

We know yet but little about light. It certainly, if not considered eternal, is to be viewed of all physical forces as the nearest related to Deity, for "His robe is the light."

This instrument is expensive, having cost 230 marks plus the duty of 25 per cent., but there is a smaller instrument made that will meet all the requirements of druggists who do not care to calculate the dispersion of light, but wish to use it only for volatile oils. It costs about 105 or 110 marks and registers from 1.30 to 1.65, and is of practical service to the pharmacist.

I would call your attention to the fact that in using the instrument you must begin with the refractive index of a pure oil. You must know it is *absolutely* pure, because this is the basis on which all other experiments are made. If you start with impure oil, you will be calculating on an impure basis. The question arises, What is there to certify that the instrument is correct? A drop of distilled water placed on the prism will read on the index of refraction 1.330, and you al-

ways adjust your instrument at the ordinary temperature to 1.330 distilled water. That is your starting point. Your instrument is correct when it reads that way, and the next thing is the pure oil. Many of the oils sold as pure, for instance, the true cinnamon oil and the oil of nutmeg, show adulteration with some oil with a lower index of refraction than the true oils. The instrument tells you the absolute purity of oils, and when one becomes thoroughly familiar with its workings, he can, in five or ten minutes, tell whether an oil is pure or not.—*Pharmaceutical Era*.

EXPERIMENTS IN EQUILIBRIUM.

TAKE two bottles of the same height, and insert in each of them a cork that has been beveled on two opposite sides at the top, and then place the bottles upon a table at a certain distance apart, and in such a way that the edges of the top of the corks shall be parallel. Upon each cork place a table knife, the blade resting

EXPERIMENT IN EQUILIBRIUM.

upon the edge of the cork through the part near the handle, pointing outwardly, and so that the two blades shall be directed toward each other without touching. Upon holding the two blades between the thumb and forefinger, the two knives will remain horizontal. With the other hand take a thin glass (a wine glass, for example) half full of water, and place it upon the two blades. After a few tentatives, either in shifting the position of the bottles or varying the quantity of water in the glass, it will become possible to keep the glass upon the blades without the aid of the hand. If a few drops of the water be removed, the glass will rise slightly with the blades, and assume the position shown in the accompanying figure.

If now a thread be taken from which is suspended a small weighty object, such as a metallic button or leaden ball, and such object be immersed in the water, the glass and blades will be observed slowly to descend. At this moment, if the thread be drawn gently upward, the glass will rise and seem to obey its motion.

If, in this way, the hand be successively raised and lowered in a regular manner, the glass will take on a vertical oscillatory motion, as if it were suspended from the thread, and begin to dance like a genuine mariolette.

ANOTHER EXPERIMENT IN EQUILIBRIUM.

The accompanying engraving illustrates an experiment that may serve to test the patience and skill of a person who wishes to pass away his time while awaiting a partner in a game of backgammon. The question is to place the thirty men of the game upon four independent men standing on edge.

EXPERIMENT WITH A BOTTLE AND CORK.

The solution of the problem requires a series of ingenious and even somewhat complicated combinations; so whoever wishes to try to solve it will do well to provide himself with a set of backgammon men, and, pieces in hand, follow us step by step in our explanation.

Lay the central piece, A, flat upon the table, and, on the prolongation of two diameters at right angles, place upon edge the pieces, 1, 2, 3, and 4, which are to

support all the rest. In order to assure of their contact with the upper edge of A, it is necessary to chock them temporarily with the four pieces, B, C, D, and E, laid flat upon the table.

Now place a piece, K, horizontally upon the edges of the pieces, 1, 2, 3, and 4. This done, place four pieces in such a way that their centers shall be respectively over the centers of the pieces, B, C, D, and E. This gives us the first horizontal row. The second row is obtained by placing four more pieces horizontally upon the four preceding ones, but so alternating them that the centers of the pieces of the second row shall be over the spaces existing between the pieces of the first row.

EXPERIMENT IN EQUILIBRIUM.

Continue alternating thus to the fifth row, the pieces of the odd rows (the black, for example) being situated directly over each other, and the pieces of the even rows having their centers likewise upon four vertical axes passing between the spaces of the columns of odd rows. The five rows dispose of 20 pieces.

Up to this point it has sufficed to operate exactly according to our directions, and no difficulty has been met with. But here is where the operation becomes ticklish. It is a question, in fact, not only of removing the pieces, B, C, D, and E, serving to chock the vertical pieces that are alone to support the structure, but also to free the two pieces, A and K, that the pieces, 1, 2, 3, and 4, hold prisoners. How shall it be done? Let us first get rid of the pieces, B, C, D, and E, and, having formed the sixth row with them, let us occupy ourselves with the two prisoners.

Upon the plan to the left remark the figures 5 and 6, placed alongside of two parallel dotted lines. These lines represent the oblique position which it is necessary to give the pieces, 2 and 3, temporarily, by deftly turning them with the finger. The piece, K, being no longer supported, falls upon A, and the two pieces, A and K, can be withdrawn though the space thus created between 2 and 3. Having placed A and K upon the sixth row, and in the center of it, return 2 and 3 to their original position, and cap the whole with the two dice boxes of the game of backgammon, one inverted over the other and supporting the two dice.

ANOTHER EXPERIMENT.

One of our readers, Prof. P. Dumont, of Nancy, communicates an experiment which appears interesting,