SCIENTIFIC USE OF THE IMAGINATION.

John Tyndall, LL.D., F.R.S., before the British Association.

[Concluded from page 320.]

I trust, Mr. President, that you—whom untoward circumstances have made a biologist, but who still keep alive your sympathy with that class of inquiries which nature intended you to pursue and adorn—will excuse me to your brethren if I say that some of them seem to form an inadequate estimate of the distance which separates the microscopic from the molecular limit, and that, as a consequence, they sometimes employ a phraseology which is calculated to mislead.

When, for example, the contents of a cell are described as perfectly homogeneous, as absolutely structureless, because the microscope fails to distinguish any structure, then I think the microscope begins to play a mischievous part. A little consideration will make it plain to all of you that the microscope can have no voice in the real question of germ structure. Distilled water is more perfectly homogeneous than the contents of any possible organic germ. What causes the liquid to cease contracting at 39° F., and to grow bigger until it freezes? It is a structural process of which the microscope can take no note, nor is it likely to do so by any conceivable extension of its powers. Place this distilled water in the field of an electro-magnet, and bring a microscope to bear upon it. Will any change be observed when the magnet is excited? Absolutely none; and still profound and complex changes have occurred.

First of all, the particles of water are rendered diamagnetically polar; and secondly, in virtue of the structure impressed upon it by the magnetic strain of its molecules, the liquid twists a ray of light in a fashion perfectly determinate both as to quantity and direction. It would be immensely interesting to both you and me if one here present, who has brought his brilliant imagination to bear upon this subject, could make us see as he sees the entangled molecular processes involved in the rotation of the plane of polarization by magnetic force. While dealing with this question he lived in a world of matter and of motion to which the microscope has no passport, and in which it can offer no aid. The cases in which similar conditions hold are simply numberless. Have the diamond, the amethyst, and the countless other crystals formed in the laboratories of nature and of man no structure? Assuredly they have, but what can the microscope make of it? Nothing. It cannot be too distinctly borne in mind that between the microscopic limit and the true molecular limit there is room for infinite permutations and combinations. It is in this region that the poles of the atoms are arranged, that tendency is given to their powers, so that when these poles and powers have free action and proper stimulus in a suitable environment, they determine first the germ and afterwards the complete organism. This first marshaling of the atoms on which all subsequent action depends baffles a keener power than that of the microscope. Through pure excess of complexity, and long before observation can have any voice in the matter, the most highly trained intellect, the most refined and disciplined imagination, retires in bewilderment from the contemplation of the problem. We are struck dumb by an astonishment which no microscope can relieve, doubting not only the power of our instrument, but even whether we ourselves possess the intellectual elements which will ever enable us to grapple with the ultimate structural energies of nature.

But the speculative faculty, of which imagination forms so large a part, will nevertheless wander into regions where the hope of certainty would seem to be entirely shut out. We think that though the detailed analysis may be, and may ever remain, beyond us, general notions may be attainable. At all events, it is plain that beyond the present outposts of microscopic inquiry lies an immense field for the exercise of the imagination. It is only, however, the privileged spirits who know how to use their liberty without abusing it, who are able to surround imagination by the firm frontiers of reason, that are likely to work with any profit here. But freedom to them is of such paramount importance that, for the sake of securing it, a good deal of wildness on the part of weaker brethren may be overlooked. In more senses than one Mr. Darwin has drawn heavily upon the scientific tolerance of his age. He has drawn heavily upon *time* in his development of species, and he has drawn adventurously upon *matter* in his theory of pangenesis. According to this theory, a germ already microscopic is a world of minor germs. Not only is the organism as a whole wrapped up in the germ, but every organ of the organism has there its special seed.

This, I say, is an adventurous draft on the power of matter to divide itself and distribute its forces. But, unless we are perfectly sure that he is overstepping the bounds of reason, that he is unwittingly sinning against observed fact or demonstrated law—for a mind like that of Darwin can never sin wittingly against either fact or law—we ought, I think, to be cautious in limiting his intellectual horizon. If there be the least doubt in the matter, it ought to be given in favor of the freedom of such a mind. To it a vast possibility is in itself a dynamic power, though the possibility may never be drawn upon.

It gives me pleasure to think that the facts and reasonings of this discourse tend rather towards the justification of Mr. Darwin than towards his condemnation, that they tend rather to augment than to diminish the cubic space demanded by this soaring speculator; for they seem to show the perfect competence of matter and force, as regards divisibility and distribution, to bear the heaviest strain that he has hitherto imposed upon them.

In the case of Mr. Darwin, observation, imagination, and reason combined have run back with wonderful sagacity and success over a certain length of the line of biological succession. Guided by analogy, in his "Origin of Species" he placed as the root of life a primordial germ, from which he conceived the amazing richness and variety of the life that now is upon the earth's surface might be deduced. If this were true it would not be final. The human imagination would infallibly look behind the germ, and inquire into the history of its genesis.

Certainty is here hopeless, but the materials for an opinion may be attainable. In this dim twilight of speculation the inquirer welcomes every gleam, and seeks to augment his light by indirect incidences. He studies the methods of nature in the ages and the worlds within his reach, in order to shape the course of imagination in the antecedent ages and worlds. And though the certainty possessed by experimental inquiry is here shut out, the imagination is not left entirely without guidance. From the examination of the solar system, Kant and Laplace came to the conclusion that its various bodies once formed parts of the same undislocated mass; that matter in a nebulous form preceded matter in a dense form; that as the ages rolled away heat was wasted, condensation followed, planets were detached, and that finally the chief portion of the fiery cloud reached, by self-compression, the magnitude and density of our sun. The earth itself offers evidence of a fiery origin; and in our day the hypothesis of Kant and Laplace receives the independent countenance of spectrum analysis, which proves the same substances to be common to the earth and sun. Accepting some such view of the construction of our system as probable, a desire immediately arises to connect the present life of our planet with the past. We wish to know something of our remotest ancestry.

On its first detachment from the central mass, life, as we understand it, could hardly have been present on the earth. How then did it come there? The thing to be encouraged here is a reverent freedom—a freedom preceded by the hard discipline which checks licentiousness in speculation—while the thing to be repressed, both in science and out of it, is dogmatism. And here I am in the hands of the meeting—willing to end, but ready to go on. I have no right to intrude upon you, unasked, the unformed notions which are floating like clouds or gathering to more solid consistency in the modern speculative scientific mind. But if you wish me to speak plainly, honestly, and undisputatiously, I am willing to do so. On the present occasion

You are ordained to call, and I to come.

Two views, then, offer themselves to us. Life was present potentially in matter when in the nebulous form, and was unfolded from it by the way of natural development, or it is a principle inserted into matter at a later date. With regard to the question of time, the views of men have changed remarkably in our day and generation; and I must say as regards courage also, and a manful willingness to engage in open contest, with fair weapons, a great change has also occurred.

The clergy of England—at all events the clergy of London—have nerve enough to listen to the strongest views which any one amongst us would care to utter; and they invite, if they do not challenge, men of the most decided opinions to state and stand by those opinions in open court. No theory upsets them. Let the most destructive hypothesis be stated only in the language current among gentlemen, and they look it in the face. They forego alike the thunders of heaven and the terrors of the other place, smiting the theory, if they do not like it, with honest secular strength. In fact, the greatest cowards of the present day are not to be found among the clergy, but within the pale of science itself.

Two or three years ago in an ancient London college—a clerical institution—I heard a very remarkable lecture by a very remarkable man. Three or four hundred clergymen were present at the lecture. The orator began with the civilization of Egypt in the time of Joseph; pointing out that the very perfect organization of the kingdom, and the possession of chariots, in one of which Joseph rode, indicated a long antecedent period of civilization. He then passed on to the mud of the Nile, its rate of augmentation, its present thickness, and the remains of human handiwork found therein; thence to the rocks which bound the Nile valley, and which team with organic remains. Thus in his own clear and admirable way he caused the idea of the world's age to expand itself indefinitely before the mind of his audience, and he contrasted this with the age usually assigned to the world.

During his discourse he seemed to be swimming against a stream; he manifestly thought that he was opposing a general conviction. He expected resistance; so did I. But it was all a mistake; there was no adverse current, no opposing conviction, no resistance, merely here and there a half humorous but unsuccessful attempt to entangle him in his talk. The meeting agreed with all that had been said regarding the antiquity of the earth and of its life. They had, indeed, known it all long ago, and they good-humoredly rallied the lecturer for coming amongst them with so stale a story. It was quite plain that this large body of clergymen, who were, I should say, the finest samples of their class, had entirely given up the ancient landmarks, and transported the conception of life's origin to an indefinitely distant past.

In fact, clergymen, if I might be allowed a parenthesis to say so, have as strong a leaning towards scientific truth as other men, only the resistance to this bent—a resistance due to education—is generally stronger in their case than in others. They do not lack the positive element, namely, the love of truth, but the negative element, the fear of error, preponderates.

The strength of an electric current is determined by two things—the electro-motive force, and the resistance that force has to overcome. A fraction, with the former as numerator and the latter as denominator, expresses the current-strength. The "current-strength" of the clergy towards science may also be expressed by making the positive element just referred to the numerator, and the negative one the denominator of a fraction. The numerator is not zero nor is it even small, but the denominator is large; and hence the current strength is such as we find it to be. Slowness of conception, even open hostility, may be thus accounted for. They are for the most part errors of judgment, and not sins against truth. To most of us it may appear very simple, but to a few of us it appears transcendently wonderful, that in all classes of society truth should have this power and fascination. From the countless modifications that life has undergone through natural selection and the integration of infinitesimal steps, emerges finally the grand result that the strength of truth is greater than the strength of error, and that we have only to make the truth clear to the world to gain the world to our side. Probably no one wonders more at this result than the propounder of the law of natural selection himself. Reverting to an old acquaintance of ours, it would seem, on purely scientific grounds, as if a Veracity were at the heart of things; as if, after ages of latent working, it had finally unfolded itself in the life of man; as if it were still destined to unfold itself, growing in girth, throwing out stronger branches and thicker leaves, and tending more and more by its overshadowing presence to starve the weeds of error from the intellectual soil.

But this is parenthetical; and the gist of our present inquiry regarding the introduction of life is this: Does it belong to what we call matter, or is it an independent principle inserted into matter at some suitable epoch—say when the physical conditions become such as to permit of the development of life? Let us put the question with all the reverence due to a faith and culture in which we all were cradled—a faith and culture, moreover, which are the undeniable historic antecedents of our present enlightenment. I say, let us put the question reverently, but let us also put it clearly and definitely.

There are the strongest grounds for believing that during a certain period of its history the earth was not, nor was it fit to be, the theater of life. Whether this was ever a nebulous period, or merely a molten period, does not much matter; and if we revert to the nebulous condition, it is because the probabilities are really on its side. Our question is this: Did creative energy pause until the nebulous matter had condensed, until the earth had been detached, until the solar fire had so far withdrawn from the earth's vicinity as to permit a crust to gather round the planet? Did it wait until the air was isolated, until the seas were formed, until evaporation, condensation, and the descent of rain had begun, until the eroding forces of the atmosphere had weathered and decomposed the molten rocks so as to form soils, until the sun's rays had become so tempered by distance and by waste as to be chemically fit for the decompositions necessary to vegetable life? Having waited through those æons until the proper conditions had set in, did it send the fiat forth, "Let life be!"? These questions define a hypothesis not without its difficulties, but the dignity of which was demonstrated by the nobleness of the men whom it sustained.

Modern scientific thought is called upon to decide between this hypothesis and another; and public thought generally will afterwards be called upon to do the same. You may, however, rest secure in the belief that the hypothesis just sketched can never be stormed, and that it is sure, if it yield at all, to yield to a prolonged siege. To gain new territory modern argument requires more time than modern arms, though both of them move with greater rapidity than of yore.

But however the convictions of individuals here and there may be influenced, the process must be slow and secular which commends the rival hypothesis of natural evolution to the public mind. For what are the core and essence of this hypothesis? Strip it naked and you stand face to face with the notion that not alone the more ignoble forms of animalcular or animal life, not alone the nobler forms of the horse and lion, not alone the exquisite and wonderful mechanism of the human body, but that the human mind itself—emotion, intellect, will, and all their phenomena—were once latent in a fiery cloud. Surely the mere statement of such a notion is more than a refutation. But the hypothesis would probably go even further than this. Many who hold it would probably assent to the position that at the present moment all our philosophy, all our poetry, all our science, and all our art—Plato, Shakespeare, Newton, and Raphael—are potential in the fires of the sun.

We long to learn something of our origin. If the evolution hypothesis be correct, even this unsatisfied yearning must have come to us across the ages which separate the unconscious primeval mist from the consciousness of to-day. I do not think that any holder of the evolution hypothesis would say that I overstate it or overstrain it in any way. I merely strip it of all vagueness, and bring before you unclothed and unvarnished the notions by which it must stand or fall.

Surely these notions represent an absurdity too monstrous to be entertained by any sane mind. Let us, however, give them fair play. Let us steady ourselves in front of the hypothesis, and, dismissing all terror and excitement from our minds, let us look firmly into it with the hard, sharp eye of intellect alone. Why are these notions absurd, and why should sanity reject them? The law of relativity, of which we have previously spoken, may find its application here. These evolution notions are absurd, monstrous, and fit only for the intellectual gibbet in relation to the ideas concerning

matter which were drilled into us when young. Spirit and matter have ever been presented to us in the rudest contrast, the one as all noble, the other as all vile. But is this correct? Does it represent what our mightiest spiritual teacher would call the eternal fact of the universe? Upon the answer to this question all depends.

Supposing, instead of having the foregoing antithesis of spirit and matter presented to our youthful minds, we had been taught to regard them as equally worthy and equally wonderful; to consider them, in fact, as two opposite faces of the self-same mystery. Supposing that in youth we had been impregnated with the notion of the poet Goethe, instead of the notion of the poet Young, looking at matter, not as brute matter, but as "the living garment of God;" do you not think that under these altered circumstances the law of relativity might have had an outcome different from its present one? Is it not probable that our repugnance to the idea of primeval union between spirit and matter might be considerably abated? Without this total revolution of the notions now prevalent the evolution hypothesis must stand condemned; but in many profoundly thoughtful minds such a revolution has already taken place. They degrade neither member of the mysterious duality referred to; but they exalt one of them from its abasement, and repeal the divorce hitherto existing between both. In substance, if not in words, their position as regards spirit and matter is: "What God hath joined together let not man put asunder."

I have thus led you to the outer rim of speculative science, for beyond the nebulæ scientific thought has never ventured hitherto, and have tried to state that which I considered ought, in fairness, to be outspoken. I do not think this evolution hypothesis is to be flouted away contemptuously; I do not think it is to be denounced as wicked. It is to be brought before the bar of disciplined reason, and there justified or condemned. Let us hearken to those who wisely support it, and to those who wisely oppose it; and let us tolerate those, and they are many, who foolishly try to do either of these things.

The only thing out of place in the discussion is dogmatism on either side. Fear not the evolution hypothesis. Steady yourselves in its presence upon that faith in the ultimate triumph of truth which was expressed by old Gamaliel when he said: "If it be of God, ye cannot overthrow it; if it be of man, it will come to nought." Under the fierce light of scientific inquiry this hypothesis is sure to be dissipated if it possess not a core of truth. Trust me, its existence as an hypothesis in the mind is quite compatible with the simultaneous existence of all those virtues to which the term Christian has been applied. It does not solve—it does not profess to solve—the ultimate mystery of this universe. It leaves in fact that mystery untouched. At bottom it does nothing more than "transport the conception of life's origin to an indefinitely distant past."

For, granting the nebula and its potential life, the question, whence came they? would still remain to baffle and bewilder us. And with regard to the ages of forgetfulness which lie between the unconscious life of the nebula and the conscious life of the earth, it is but an extension of that forgetfulness which preceded the birth of us all. Those who hold the doctrine of evolution are by no means ignorant of the uncertainty of their data, and they yield no more to it than a provisional assent. They regard the nebular hypothesis as probable, and in the utter absence of any evidence to prove the act illegal, they extend the method of nature from the present into the past. Here the observed uniformity of nature is their only guide. Within the long range of physical inquiry they have never discerned in nature the insertion of caprice. Throughout this range the laws of physical and intellectual continuity have run side by side. Having thus determined the elements of their curve in this world of observation and experiment, they prolong that curve into an antecedent world, and accept as probable the unbroken sequence of development from the nebula to the present time.

You never hear the really philosophical defenders of the doctrine of uniformity speaking of *impossibilities* in nature. They never say, what they are constantly charged with saying, that it is impossible for the builder of the universe to alter His work. Their business is not with the possible, but the actual; not with a world which *might* be, but with a world which *is*. This they explore with a courage not unmixed with reverence, and according to methods which, like the quality of a tree, are tested by their fruits. They have but one desire—to know the truth. They have but one fear—to believe a lie. And if they know the strength of science, and rely upon it with unswerving trust, they also know the limits beyond which science ceases to be strong. They best know that questions offer themselves to thought which science, as now prosecuted, has not even the tendency to solve. They keep such questions open, and will not tolerate any unlawful limitation of the horizon of their souls. They have as little fellowship with the atheist who says there is no God as with the theist who professes to know the mind of God.

"Two things," said Immanuel Kant, "fill me with awe: the starry heavens and the sense of moral responsibility in man." And in his hours of health and strength and sanity, when the stroke of action has ceased and the pause of reflection has set in, the scientific investigator finds himself overshadowed by the same awe. Breaking contact with the hampering details of earth, it associates him with a power which gives fulness and tone to his existence, but which he can neither analyze nor comprehend.

COL. FISHER, Ex-Commissioner of Patents, has returned to the practice of law at Cincinatti.

NOTES AND MAXIMS ABOUT HEALTH.

BY DR. DIO LEWIS.

Gluttony counts one hundred victims where drunkenness counts one.

To regulate health we must regulate diet.

Certain kinds of food feed the fat and leave the muscles and brain to starve. Certain other foods feed the muscles exclusively, and certain others the brain. A large part of the food of Americans is composed of white flour, sugar, and butter. People who try to live upon such stuff gradually starve to death.

There is a gentleman in Boston who has amassed an immense fortune. His carriage is the finest in the neighborhood, and he wastes money lavishly; but his face is the picture of despair. Life is a torture to him, because he is nervous and dyspeptic. Half the rich men and women belong to the category of the miserable; they cannot digest their dinners.

The common notion that our health and life depend upon a mysterious Providence is downright infidelity. A child goes out of a hot room with naked arms and legs in pursuit of its daily supply of poisoned candies, and then dies of croup. Is that a mysterious Providence? If a man indulges himself until he gets the gout, and the disease attacks his heart and kills him, is his death a mystery?

The reason that the American people are such dyspeptics is that they eat and drink so much, and eat and drink so fast.

The teeth will not decay if they are kept clean. A toothbrush is a good thing, but one good toothpick is worth an armful of toothbrushes. There is a gentleman now living in New York city who has three beautiful front teeth which he purchased from the mouth of an Irishman. His own teeth were removed and instantly Patrick's were transferred.

The process of digestion begins in the mouth and ends in the lungs. The mouth grinds the food; the lungs supply the oxygen which converts the products of the food into pure and useful blood.

Dr. Lewis once attended the lecture of a Thomsonian doctor who explained the use of mercury as follows:

"And now do you know how marcury produces the rheumatiz? I'll tell you exactly how marcury produces the rheumatiz. You see marcury has a great many sharp pints, and them sharp pints go straight in the flesh, and when the muscles rub over them sharp pints it scratches, and that's the rheumatiz."

Many people imagine themselves afflicted with serious diseases when they are only suffering from dyspepsia. A dyspeptic patient always despairs; a consumptive always hopes.

John Abernethy was the greatest man the medical profession has produced in modern times. Perhaps no other man has contributed so much to temperance in eating as he.

To make the best bread that can be made of wheat, obtain good wheat and grind it without bolting; mix it with cold water until it is as thick as can be well beaten with a spoon; after it is thoroughly beaten down, put it into a large iron pan, composed of many little ones, which must first be made hot; put it then quickly into a hot oven, and bake it rapidly as possible.

Indian corn makes excellent nourishment. It contains a large amount of oil, has remarkable fattening qualities, and is likewise remarkable as a heat producer. Rice keeps its consumers fat, but it lacks the elements which feed the muscles and brain.

Potatoes, both Irish and sweet, are very poor food for brain and muscle.

Of meats, the best for heat and fat are pork, mutton, lamb, beef, and veal; for muscle, beef, veal, mutton, lamb, and pork; for brain and nerve, beef, veal, mutton, lamb, and pork.

In cold weather, fat meat, butter, and the like will keep the body warm; and in warm weather milk, eggs, bran-bread, and summer vegetables will keep it cool.

There is no difficulty in a poor man's having meat for his family every day. Take, for example, what is called a shank of beef. The very best can be bought for a fraction of what the dearest parts cost. A single pound cooked in a stew with dry bits of bread will make a meal for an entire family.

The Greek and Roman armies ate but once a day.

The common impression that tomatoes are the healthiest of all vegetables is a mistake. If eaten at all, it should be with great moderation, and never raw. Tomatoes have sometimes produced salivation. Dr. Lewis knew a young woman who had lost all her teeth from excessive eating of tomatoes.

Pies and cakes are poisonous.

To healthy persons mineral waters are not wholesome.

Corsets are most injurious to digestion. Their use finally results in an immense and very ugly protuberance of the abdomen.

Light and sunshine are indispensable to health, and great curative agents in disease.

Those who suffer from heartburn, should avoid soups, drink nothing at meals, say "No, thank you," to pies and cakes, and go without supper.

If you wish to live to eighty-five in the full enjoyment of all your faculties, go to bed at 9 o'clock, and eat twice a day a moderate quantity of plan food.

The native American requires more sleep than the average European. Nine or ten hours' sleep in a single night is very beneficial. Thin Yankees should go to bed at nine and rise between five and six.

In a girl's school which Dr. Lewis conducted with great success at Lexington, Massachusetts, the health rules were as follows:

"To go to bed at half-past eight every evening, to rise early in the morning and take a walk, to walk a second time during the day, to eat only twice a day plain nourishing food, to wear no corsets, to exercise twice a day half an hour in gymnastics, and to dance an hour for about three times a week. The gymnastic exercises proved invaluable; but the nine hours in bed were still more so."

The word biliousness is a sort of respectful cover for pigishness. People are not bilious who eat what they should.

Weakness of the stomach is a protection against other maladies. So dyspepsia is the safety valve, and may be spoken of as one of the sources of longevity.

People who are fat can easily be reduced by reducing their food and giving them more exercise. Such persons must not sleep too much. Long sleep fattens. Thin people, on the contrary, should sleep a great deal.

Military Chemistry.

There is one department in the British service which has been of the most essential service ever since its establishment, viz., the Department of Chemistry. It was, says the *Public Ledger*, formed during the Crimean war, at the suggestion of the illustrious Faraday, to check the frauds of the contractors for army supplies at that time. The Minister of War allotted to it a large space in Woolwich Arsenal, fitted up with laboratories, provided with every species of apparatus, with fine balances for estimating results, with the most powerful microscopes, with machinery for analyzing gases, with photographic studios, etc., etc., all of which were placed under the control of a distinguished professor of chemistry and half a dozen well-skilled practical assistants, whose time is fully employed in a variety of matters, and just now, especially, in testing metal for the manufacture of guns and projectiles, in examining the elements of gunpowder, in analyzing the stores and food of the soldier, and in many other experiments of a similar kind.

It is somewhat surprising that such an establishment was not founded long ago, familiar as all the world is with the tricks of contractors in times of public necessity, as during a war. It is a melancholy fact that there should exist a class of men who have no scruple in sacrificing, not merely the health and lives of their fellow men, but the very safety and existence of their country, in order that they may make money out of its necessities.

We need only turn our eyes to France at the present moment for a sample of what these men are capable of. What French contractors have done lately, English contractors did during the Crimean war, and American contractors did during our civil war. The guilt seems to be characteristic of the class generally, and not of any one nation in particular. But the good effects of such an institation as the British Military Department of Chemistry were shown in the recent Abyssinian war, when out of a large number of articles supplied to the troops none were complained of, for they had previously been tested by the Department.

The rule now is, that when tenders are sent in for supplying stores to the army, the contractors are bound to forward, at the same time, specimens of the material they intend to supply. These samples are carefully tested in the chemical department, and the firm that offers the most suitable articles at the lowest prices receives an order to supply the goods. Subsequently, when these are sent in, a further examination takes place to ascertain whether they are equal to the samples first submitted, and only if this proves to be the case are the stores accepted and paid for.

The number and variety of the articles operated upon is extraordinary. Almost all the belongings of the soldier pass in one way or other under the eyes of these chemical detectives. The cloth of his coat, the thread with which it is sewn, the gold lace, the accoutrements, are all tested, and the buttons he wears must be covered with a film of metal sufficiently strong to withstand the action of the acid which the chemist applies to them. The bread, milk, flour, biscuit, preserved meat, vegetables, fruit, etc., of his rations are periodically sent to Woolwich to be tested, and it is said that the system has been so rigorously applied throughout the service that, even at remote stations, flagrant cases of fraud are now rare.

Considerable pains are taken to provide wholesome drinking water in barracks, and a very large portion of the work of the chemical department is devoted to this point. Specimens of the water used at the military stations abroad as well as at home are forwarded to the arsenal for analysis, and reports as to its qualities, together with advice to the commanding officers, are sent to the different stations. Barrack and equipment stores are not forgotten. Soap, candles, oils, coal, coke, emery dust, varnish, blacking, paper hangings, and all kinds of paint are analyzed carefully in order to prevent the injurious action of arsenic, lead, and other poisonous metals. Soap, in particular, is always severely tested, by reason of the facility with which it may be adulterated, and because it is used in such large quantities.

Very great vigilance is also exercised over camp equipage the making of the canvas uninflammable and unfavorable to the formation of mildew, the perfecting of the india-rubber coating for the ground sheets on which the soldier spreads his blankets, and other like cares also occupy the department. The services it has rendered are immense. The condition of the modern soldier is very different from that of the soldier of even half a century ago, when he was looked upon as little better than "food for powder."

THE war is effecting the tobacco trade of this country adversely, France and Germany being the largest consumers of Europe, and with England requiring, during the year ended June 30, 1870, 186,000,000 pounds of leaf tobacco, 2,064,000 cigars, and 20,181 pounds of snuff.