

THE OPEN COURT.

A WEEKLY JOURNAL

DEVOTED TO THE RELIGION OF SCIENCE.

No. 376. (VOL. VIII.—45.)

CHICAGO, NOVEMBER 8, 1894.

{ Two Dollars per Year.
{ Single Copies, 5 Cents.

COPYRIGHT BY THE OPEN COURT PUBLISHING CO.—Reprints are permitted only on condition of giving full credit to Author and Publisher.

THE PILGRIMAGE OF ANTHONY FROUDE.

BY MONCURE D. CONWAY.

I.

JAMES ANTHONY FROUDE was not only the ablest historian of England, but himself a historic figure. He was the last author who had the distinction of having one of his books formally burned at Oxford, the first to avail himself of the law allowing clergymen to free themselves entirely from holy orders, and he lived to be appointed (1892) Professor of History in the University where his book was burned. He was appointed too by a Tory prime minister. It took just forty-four years for the angry Nemesis of Oxford faith to be thus finally extinguished by the Nemesis of English rationalism. According to a contemporary authority (*The Prospective Review*, Vol. V., p. 163), the *Nemesis of Faith*, published in 1848, was "solemnly" burned in the Public Hall of Exeter College (of which Froude was a Fellow) by the Senior Tutor, who made a funeral speech over it. Mr. Froude was too modest a man to call attention to picturesque points in his personal history, and their significance has escaped attention because his intellectual progress has been too individual and too scholarly to excite public discussion. Flutes are drowned by drum-beats, as Sâdj says; and in religion the air is always resonant with drums. I have even now been reading obituary notices which ignore the spiritual career of Froude, and speak of him as a mere layman. Seventeen years ago, when the third series of his *Short Studies on Great Subjects* was under review, I received a note from Froude on another matter, at the close of which he says:

"My little volume of historical essays has sold very well, and has now come out in a cheaper form. No one, however, seems to have caught what I meant either by 'Divers Cæsar' or by the 'Sea Studies.' One must not count on any exertion of intellect on the part of one's readers. They must be told straight out what one intends, or they miss the point—though as plain as the conclusion of a syllogism."

The two essays named in the note, taken in conjunction with that on "Lucian" in the same volume, represent as trenchant and comprehensive an account of the natural history of Christianity, and its evolution out of so-called paganism, as was ever condensed into

a hundred pages. Nor is there the slightest veil on the scholar's thought as the temple-veil of supernaturalism shrivels away at his touch. Only his touch is sympathetic, generous, delicate. And as there are freethinkers who can never receive a kind word from an orthodox man without setting him down as a secret unbeliever, so there are orthodox people who can never hear a respectful word from a freethinker without regarding him as a disguised believer. "I could never attack Christianity," Froude once said to me; "I would as soon think of demanding extermination of the horse. The thing is here,—bred for certain work, and doing it in a fashion. Were the horse set up to be worshipped as a sacred animal, scientific explanations would become necessary. So with any institution. So with Christianity." I remember these forcible words, and that afterwards Froude argued that as Christianity had been fashioned and refashioned again and again, it might be adapted to new needs, could there be produced spirits finely touched for such fine issues. "As for the superstitions investing Christianity, they inevitably moulder, and hardly concern us so much as the growing superstitions which fancy themselves reasonable and progressive."

I conclude this first paper with two remarkable passages from *The Nemesis of Faith*, a book now rare, to which probably few of your readers have access. It should be borne in mind that it was written forty-four years ago, when the comparative study of religions was in its infancy.

"People canvass up and down the value and utility of Christianity, and none of them seem to see that it was the common channel towards which all the great streams of thought in the Old World were tending, and that in some form or other when they came to unite it must have been. That it crystallised round a particular person may have been an accident; but in its essence, as soon as the widening intercourse of the nations forced the Jewish mind into contact with the Indian and the Persian and the Grecian, such a religion was absolutely inevitable.

"It was the development of Judaism in being the fulfilment of the sacrificial theory, and the last and purest conception of a personal God lying close above the world, watching, guiding, directing, interfering.

Its object was no longer the narrow one of the temporal interests of a small people. The chrysalis had burst its shell, and the presiding care extended to all mankind, caring not now for bodies only but for souls. It was the development of Parseism in settling finally the vast question of the double principle, the position of the evil spirit, his history, and the method of his defeat; while Zoroaster's doctrine of a future state was now for the first time explained and justified; and his invisible world of angels and spirits, and the hierarchies of the seven heavens, were brought in subjection to the same one God of the Jews.

"It was the development of the speculative Greek philosophy of the school of Plato, of the doctrine of the Spirit, and the mysterious Trinity, the *ἐν καὶ πᾶν*, the word or intellect becoming active in the primal Being; while, lastly, the Hindu doctrine of the incarnation is the uniting element in which the other three combine, and which interpenetrates them with an awful majesty, which singly they had not known.

"So these four streams uniting formed into an enormous system, comprehending all which each was seeking for, and bringing it all down home, close to earth, human, direct, and tangible, and supplying mankind with full measure of that spiritual support with which only minds most highly disciplined can afford to dispense."

The other passage—I condense it with reluctance—can hardly be matched in literature for refined eloquence. It is from a letter written by a young clergyman, troubled by sceptical doubts, to his friend:

"There is a village in the wood, two or three miles from here—there was an abbey there once. But there is nothing left of the abbey but its crumbling walls, and it serves only for a burying-ground and for sentimental picnic parties. I was there to-day; I sat there a long time, I do not know how long—I was not conscious of the place. I was listening to what it was saying to me. I will write it down and look at it, and you shall look at it: an odd enough subject for a Christian ruin to choose—it began to talk about paganism. 'Do you know what paganism means?' it said. Pagani, pagans, the old country villagers. In all history there is no more touching word than that one of Pagan. In the great cities, where men gather in their crowds and the work of the world is done, and the fate of the world is determined, there it is that the ideas of succeeding eras breed and grow and gather form and power, and grave out the moulds for the stamp of after ages. There it was, in those old Roman times, that the new faith rose in its strength, with its churches, its lecture-rooms, its societies. It threw down the gorgeous temples, it burnt their carved cedar work, it defiled the altars and scattered the ashes to the winds. The statues were sanctified and made

the images of saints, the augurs' colleges were rudely violated, and they who were still faithful were offered up as martyrs or scattered as wanderers over the face of the earth, and the old gods were expelled from their old dominion—the divinity of nature before the divinity of man. . . . 'And now look at me,' the old ruin said; 'centuries have rolled away, the young conqueror is decrepit now; dying, as the old faith died, in the scenes where that faith first died; and lingering where it lingered. The same sad, sweet scene is acting over again. I was the college of the priests, and they are gone, and I am but a dead ruin, where the dead bury their dead. The village church is outliving me for a few more generations; there still ring, Sunday after Sunday, its old reverend bells, and there come still the simple peasants in their simple dresses—pastor and flock still with the old belief; there beneath its walls and ruins they still gather down into the dust, fathers and children sleeping there together, waiting for immortality; wives and husbands resting side by side in fond hope that they shall wake and link again the love-chain which death has broken; so simple, so reverend, so beautiful! Yet is not that, too, all passing away, away beyond recall? The old monks are dead. The hermit-saints and hallowed relics are dust and ashes now. The fairies dance no more around the charmed forest ring. They are gone, gone even here. The creed still seems to stand; but the creed is dead in the thoughts of mankind. Its roots are cut away, down where alone it can gather strength for life, and other forms are rising there; and once again, and more and more, as day passes after day, the aged faith of aged centuries will be exiled as the old was to the simple inhabitants of those simple places. Once, once for all, if you would save your heart from breaking, learn this lesson—once for all you must cease, in this world, to believe in the eternity of any creed or form at all. Whatever grows in time is a child of time, and is born and lives, and dies at its appointed day like ourselves. . . . Life is change; to cease to change is to cease to live; yet if you may shed a tear beside the death-bed of an old friend, let not your heart be silent on the dissolving of a faith.'"

HOLMES'S ANTI-DOGMAS.

BY DR. FELIX L. OSWALD.

A FEW months ago the freethinkers of the semi-French city of Barcelona arranged a festival to celebrate the news from a little town in western Aragon, where a gang of ruffians had attacked a supposed witch and dragged her about in a sack, till they were routed by the alcalde with a posse of local rationalists.

"What a sign of the times," said the orator of the symposium, "and what a step of progress since the days when that mob would have been headed by a pro-

cession of *mata-bruxas*,"—official witch-hunters with their inquisitorial experts and faggot-contractors.

In a similar manner the American Liberals of the last fifty years ought to have appreciated the physical and moral survival of the wizard Holmes. The *mata-bruxas* of the American Inquisition, it is true, were on his track for a while; and some of his heresies have neither been forgotten nor forgiven; but what a stride of progress since the time when Unitarians were thought unfit to practise law or medicine, and when the bigots who released Thomas Campanella, after spraining a few of his joints, would probably have burnt Holmes for attacking their centre-dogma and exposing the roots of their delusions.

Nor is it probable that the physicians of the sixteenth century would have protested against a sentence of that kind. Holmes's reform-theories were not limited to educational topics, and the keenest shafts of his wit were about evenly distributed between the religion of John Calvin, the abuse of drugs, and the vice of moral cowardice, *alias*, the conventional silence about the absurdities of a dominant creed.

"Far better," he says, "to be a *bonnet rouge*, a red cap of the barricades, my friends, than to be a conservatist, if conservatism makes it our duty to let all the drains of thought choke up and keep the soul's windows down, to shut out the sun and the breezes, till the soul sickens with moral typhus and we begin to snore in its coma or rave in its delirium. . . ."

"Or, is it not true that Truth gets well if she is run over by a locomotive, while Error dies of lockjaw if she scratches her finger? I never heard of a mathematician being alarmed for the safety of a demonstrated proposition, and I think that the dread of discussion generally implies feebleness of inward conviction."

"Suppose," says his Professor, in quizzing an adversary on the dogma of total depravity, "suppose the Medical Society should refuse to give us an anodyne or set a broken limb, until we had signed our belief in a certain number of propositions, of which, we will say, this is the first: (1) 'All men's teeth are naturally in a state of total decay, and therefore no man can bite until every one of them is extracted and a new set inserted, according to the principles of dentistry adopted by this Society.' Of course, those doctors would have a right to say we shan't have any rhubarb if we don't sign these articles. . . . but then to ask a fellow not to discuss their propositions before he signs them is what I should call boiling it down a little too strong."

Like Frederick Schiller, Holmes pleads his *religion* as an excuse for his aversion to sham creeds. "The main-spring of the world's onward religious movement," he says, "is not in the Church. . . . It is the people that makes the clergy, and not the clergy that

makes the people. There never was a guild of dealers or a company of craftsmen that did not need sharp looking after."

"You may think me little better than a heathen," says he, in parrying the attack of another critic, "but let me ask you, which seems to you nearest heaven: Socrates drinking his hemlock, Regulus going back to the enemy's camp, or that old New England divine, sitting comfortably in his study and chuckling over his conceit of a poor old woman who had been burned to death in his own town, going 'roaring out of one fire into another' . . . or the Rev. Mr. Calvin and his associates, who burned my distinguished scientific brother with green faggots?" . . . The dogmas of such people about the Father of Mankind and his creatures are of no more account in my opinion than those of a council of Aztecs."

Moritz Carriere, in his *Doctrines of the Reformation*, ventures a similar remark, but would hardly have risked the following impeachment of contemporary bigots: "In our lunatic asylums," says the Beacon Street philosopher, "we frequently see persons sent there in consequence of what are called religious mental disturbances. I confess that I think better of them than of many who hold the same opinions and keep their wits and appear to enjoy life very well, outside of the asylums. Any decent person ought to go mad if he really holds such opinions. It is very much to his discredit, in every point of view, if he does not. Anything that is brutal, cruel, and makes life hopeless for most of mankind, and perhaps for whole races,—*anything that assumes the necessity of exterminating instincts which were given to be regulated, if received, ought to produce insanity in every well-regulated mind.* I am very much ashamed of some people for retaining their reason, when they ought to know perfectly well, that if they were not the most stupid or most selfish of human beings they would become *non-computes* at once."

That the perpetrator of those diatribes escaped the penalty of social ostracism would be a mystery even to a community of liberals, if it were not for the fact that Holmes reserved his protests for a period when his reputation and popularity had already been firmly established, and that in New England that period moreover coincided with a revival of the intellectual reform set in motion by the writings of Franklin and Paine. That movement continued long enough to alarm the obscurantists for the safety of their own strongholds, and deter them from the risk of increasing the odium of their polemics by a persistent crusade against a favorite of the English-reading nations. "It amuses me," he says, "to look back at some of the attacks provoked by my controversial essays. Opinions which do not excite the faintest show of temper at this time from those who do not accept them,

were treated as if they were the utterances of a nihilistic incendiary." (*The Professor*, Preface of 1882.)

"Some persons," he adds, "may even now take offence at certain expressions of my opinions; but a day may come when they will be thought too timid and conservative for intelligent readers."

His views on the Nemesis of Faith differed, indeed, widely from those of his friend Froude. "Do you ask what plague has fallen on the practitioners of theology?" he says, after pointing out the disintegrating tendency of Homeopathy, in its effect upon the old-school theories of medicine. "I will tell you, then. It is *Spiritualism*. While some are crying out against it as a delusion of the Devil, and some are laughing at it as an hysteric folly, and some are getting angry with it as a mere trick of interested or mischievous persons, Spiritualism is quietly undermining the traditional ideas of the future state which have been and are still accepted,—not merely in those who believe in it, but in the general sentiment of the community to a larger extent than most good people seem to be aware of. It needn't be true, to do this, any more than Homeopathy need, to do its work. The Spiritualists have some pretty strong instincts to pry over, which no doubt have been roughly handled by theologians at different times. And the Nemesis of the pulpit comes in a shape it little thought of. You cannot have people of cultivation, of pure character, large-hearted women, grave judges, men of science, shrewd businessmen, professing to be in communication with the spirit world and keeping up constant intercourse with it, without it gradually reacting on the whole conception of that other life. . . ."

" . . . In point of fact, it is one of the many results of Spiritualism to make the permanent destiny of the race a matter of common reflexion and discourse, and a vehicle for the prevailing disbelief in the Middle-Age doctrines on the subject . . . a subject that involves all we have and all we hope, not merely for ourselves, but for the dear people whom we love best,—noble men, pure and lovely women, ingenuous children—about the destiny of nine tenths of whom you know the opinions that would have been taught by those old man-roasting, woman-strangling dogmatists."

Holmes's doxy, however, had a positive as well as negative mission. "The great end of existence," he says, "is to harmonise man with the established order of things"—one of the best extant summaries of the religion of nature. "Do you think there is a chance of a future existence?" asked one of his New England friends. "I hope so," said Holmes, and his private speculations on that point appear to have varied from agnosticism to a kind of vague and poetic pantheism. "In the hearts of many men and women, and let me

add children, there is a foreboding that there is a *Great Secret waiting for them*," says he in his essay on the metaphysics of love (*The Professor*, p. 177), "a secret of which they get hints now and then, perhaps oftener in early than in later years. These hints come sometimes in dreams, sometimes in sudden, startling flashes,—second wakings, as it were,—a waking out of the waking state which last is very apt to be a half-sleep. I have many times stopped short and held my breath, and felt the blood leaving my cheeks, in one of those sudden clairvoyant flashes. Of course, I cannot tell what kind of a secret this is, but I think of it as a disclosure of certain relations of our personal being to time and space, to other intelligences, to the procession of events, and to their First Great Cause. The revelations of this secret are broken up, as it were, into fragments, but are never written out for most of us as a complete sentence, in this life. I do not think it could be; for I am disposed to consider our belief about such a possible disclosure rather as a kind of a premonition of an enlargement of our faculties in some future state of existence. . . . Glimpses of it are now and then revealed in the face of a beautiful woman, but not in the words of Love. The Secret, I mean, lies deeper than Love. Some, I think,—Wordsworth, for instance,—spell out a portion of it from certain beautiful natural objects, landscapes, flowers, and others. I could mention several poems that have shadowy hints which seem to me to come near the region where I think it lies."

Had Holmes read Goethe's "Ganymede," or did his allusions circumscribe a hint that there are higher ideals of ethics than the worship of sorrow? "Cheerfulness," he says, "is something more than a virtue, it is a duty which the human soul owes to its physical yoke-fellow." "Of our duties to the Head physician of this vast planetary ambulance which we call Earth, I need say little," he tells the graduates of his Harvard class; "we read the Creator chiefly through his creatures. If performed in the right spirit there is no higher worship than the unpurchased service of the medical priesthood. The sick man's faltered blessing reaches heaven through the battered roof of a hovel before the Te Deum that reverberates through vast cathedrals."

For a Fellow of the Massachusetts Medical Society, and Harvard Professor of Anatomy and Physiology, his remarks on the fallacies of the orthodox drug-school are surprisingly candid. "We cannot yet dispense with opium," he says, "nor with the vapors that work the miracle of anæsthesia, but if the whole of our materia medica, with the exceptions named, could be flung to the bottom of the sea, it would be all the better for mankind—and all the worse for the fishes." (*Currents and Counter Currents*, p. 39.)

"Look at medicine," says his Professor, "big wigs, gold-headed canes, Latin prescriptions, shops full of abominations, recipes a yard long, 'curing' patients as a sailor brings a wind by whistling, selling lies at a guinea a piece,—a routine, in short, of giving unfortunate sick people a mess of things either too odious to swallow or too acrid to hold."

His pamphlet on *Homeopathy and Its Kindred Delusions*, provoked a storm of controversy almost unparalleled in the history of medical literature, but his chief objection to the system of Hahnemann was, after all, a misgiving that it would keep alive the popular belief in the necessity of drug-remedies and thus prove a barrier to the progress of hygienic reform.

Holmes's views on the temperance problem were at first those of the "mild stimulant school" of his European colleagues, but further reflexion made him recognise the progressive tendency of the alcohol habit, and his ultimate verdict on the doctrine of Anacreon was nearly expressed in his parody of a Bacchanalian ode:

"Come, fill a fresh bumper,—for why should we go
While the *nectar* (logwood) still reddens our cups as they flow!
The *purple-hued clusters* (half-ripened apples) their life-dews have bled,
How sweet is the *breath* (taste) of the *fragrance they shed* (sugar of lead)
For summers *last roses* (rank poison) lie hid in the wines,
That were garnered by *maidens who laughed through the vines* (stable-boys
smoking long nines).
Then a *smile* (scowl) and a *glass* (howl) and a *toast* (scoff) and a *cheer* (sneer)
For all the *good wine*, and *we've some of it here* (strychnine and whiskey, and
ratsbane and beer)
In cellar, in pantry, in attic, and ball,
Long live the gay servant that laughs for us all (Down, down, with the tyrant
that ruins us all)."

"The sun does not look quite as bright as formerly," wrote the genial octogenarian a few years ago, "and my resources of comfort are getting more and more limited to the 'warmth within that comes from cold without'; still I cannot say that I long for the night which I have never feared, and like that paralytic French philosopher, mentioned by Edmond About, I shall have no objection, *par pure curiosité*, to tarry a little longer, and wait for the next surprise of this age of wondrous inventions."

Holmes's sombre moods, indeed, never bordered on pessimism. Among the discords of a moral chaos he had tried to achieve self-salvation by conformity to the religion of science, and to the very end of his long life the successful solution of that problem was attested by the enjoyment of almost perfect health, and the still rarer blessing of a harmonious mind.

ON THE PRINCIPLE OF COMPARISON IN PHYSICS.¹

BY PROF. ERNST MACH.

TWENTY years ago when Kirchhoff defined the object of mechanics as the "description, in complete and very simple terms, of the motions which occur in na-

¹An address delivered before the General Session of the German Association of Naturalists and Physicians, at Vienna, Sept. 24, 1894.

ture," he produced a peculiar effect by the statement. Fourteen years subsequently, Boltzmann, in the life-like picture which he drew of the great inquirer, could still speak of the universal astonishment at this novel method of treating mechanics, and we meet with epistemological treatises to-day, which plainly show how difficult is the acceptance of this point of view. A modest and small band of inquirers there were, however, to whom Kirchhoff's few words were tidings of a welcome and powerful ally in the epistemological field.

Now, how does it happen that we yield our assent so reluctantly to the philosophical opinion of an inquirer for whose scientific achievements we have only unqualified praise? One reason probably is that few inquirers can find time and leisure, amid the exacting employments demanded for the acquisition of new knowledge, to inquire closely into that tremendous psychological process by which science is formed. Further, it is inevitable that much should be put into Kirchhoff's lapidary words that they were not originally intended to convey, and that much should be found wanting in them that had always been regarded as an essential element of scientific knowledge. What can mere description accomplish? What has become of explanation, of our insight into the causal connexion of things?

* * *

Permit me, for a moment, to contemplate not the results of science, but the mode of its *growth*, in a frank and unbiassed manner. We know of only *one* source of *immediate revelation* of scientific facts—*our senses*. Restricted to this source alone, thrown wholly upon our own resources, obliged to start always anew, what could the isolated individual accomplish? Of a stock of knowledge so acquired the science of a distant negro hamlet in darkest Africa could hardly give us a sufficiently humiliating conception. For there that veritable miracle of thought-transference has already begun its work, compared with which the miracles of the spiritualists are rank monstrosities—*communication by language*. Reflect, too, that by means of the magical characters which our libraries contain we can raise the spirits of the "the sovereign dead of old" from Faraday to Galileo and Archimedes, through ages of time—spirits who do not dismiss us with ambiguous and derisive oracles, but tell us the best they know; then shall we feel what a stupendous and indispensable factor in the formation of science *communication* is. Not the dim, half-conscious *surmises* of the acute observer of nature or critic of humanity belong to science, but only that which they possess clearly enough to *communicate* to others.

But how, now, do we go about this communication of a newly acquired experience, of a newly observed fact? As the different calls and battle-cries of gregarious animals are unconsciously formed signs for

a common observation or action, irrespective of the causes which produce such action—a fact that already involves the germ of the concept; so also the words of human language, which is only more highly specialised, are names or signs for universally known facts, which all can observe or have observed. If the mental representation, accordingly, follows the new fact at once and *passively*, then that new fact must, of itself, be immediately constituted and represented in thought by facts already universally known and commonly observed. Memory is always ready to put forward for *comparison* known facts which resemble the new event, or agree with it in certain features, and so renders possible that elementary internal judgment which the mature and definitely formulated judgment soon follows.

Comparison, as the fundamental condition of communication, is the most powerful inner vital element of science. The zoölogist sees in the bones of the wing-membranes of bats, fingers; he compares the bones of the cranium with the vertebrae, the embryos of different organisms with one another, and the different stages of development of the same organism with one another. The geographer sees in Lake Garda a fjord, in the Sea of Aral a lake in process of drying up. The philologist compares different languages with one another, and the formations of the same language as well. If it is not customary to speak of comparative physics in the same sense that we speak of comparative anatomy, the reason is that in a science of such great experimental activity the attention is turned away too much from the *contemplative* element. But like all other sciences, physics lives and grows by comparison.

* * *

The manner in which the result of the comparison finds expression in the communication, varies of course very much. When we say that the colors of the spectrum are red, yellow, green, blue, and violet, the designations employed may possibly have been derived from the technology of tattooing, or they may subsequently have acquired the significance of standing for the colors of the rose, the lemon, the leaf, the cornflower, and the violet. From the frequent repetition of such comparisons, however, made under the most manifold circumstances, the inconstant features, as compared with the permanent congruent features, get so obliterated that the latter acquire a fixed significance independent of every object and connexion, or take on as we say an *abstract* or *conceptual* import. No one thinks at the word "red" of any other agreement with the rose than that of color, or at the word "straight" of any other property of a stretched cord than the sameness of direction. Just so, too, numbers, originally the names of the fingers of the hands and feet,

from being used as arrangement-signs for all kinds of objects, were lifted to the plane of abstract concepts. A verbal report (communication) of a fact that uses only these purely abstract implements, we shall call in this essay a *direct description*.

The direct description of a fact of considerable extent is an irksome task, even where the requisite notions are already completely developed. What a simplification it involves if we can say, the fact *A* now considered comports itself, not in *one*, but in *many* or in *all* its features, like an old and well-known fact *B*. The moon comports itself like a heavy body does with respect to the earth; light like a wave-motion or an electric vibration; a magnet, as if it were laden with gravitating fluids, and so on. We call such a description, in which we appeal, as it were, to a description already and elsewhere formulated, or perhaps still to be precisely formulated, an *indirect description*. We are at liberty to supplement this description, gradually, by direct description, to correct it, or to replace it altogether. We see, thus, without difficulty, that what is called a *theory* or a *theoretical idea*, falls under the category of what is here termed indirect description.

* * *

What, now, is a theoretical idea? Whence do we get it? What does it accomplish for us? Why does it occupy a higher place in our judgment than the mere holding fast to a fact or an observation? Here, too, memory and comparison alone are in play. But instead of a *single* feature of resemblance culled from memory, in this case a *great system* of resemblances confronts us, a well-known physiognomy, by means of which the new fact is immediately transformed into an old acquaintance. Besides, it is in the power of the idea to offer us more than we actually see in the new fact, at the first moment; it can extend the fact, and enrich it with features which we are at first induced to *seek* from such suggestions, and which are often actually found. It is this *rapidity* in extending knowledge that gives to theory a preference over simple observation. But that preference is wholly *quantitative*. Qualitatively, and in real essential points, theory differs from observation neither in the mode of its origin nor in its last results.

The adoption of a theory, however, always involves a danger. For a theory puts in the place of a fact *A* in thought, always a *different*, but simpler and more familiar fact *B*, which in *some* relations can mentally represent *A*, but for the very reason that it is *different*, in other relations cannot represent it. If now, as may readily happen, sufficient care is not exercised, the most fruitful theory may, in special circumstances, become an outright obstacle to inquiry. Thus, the emission-theory of light, in accustoming the physicist to think of the projectile path of the "light-particles"

as an undifferentiated straight-line, demonstrably impeded the discovery of the periodicity of light. By putting in the place of light the more familiar phenomena of sound, Huygens renders light in many of its features a familiar event, but with respect to polarisation, which lacks the longitudinal waves with which alone he was acquainted, it had for him a doubly strange aspect. He is unable thus to grasp in abstract thought the fact of polarisation, which is before his eyes, whilst Newton, merely by adapting to the observation his thoughts, and putting this question, "*Annon radiorum luminis diversa sunt latera?*" abstractly grasped polarisation, that is, directly described it, a century before Malus. On the other hand, if the agreement of the fact with the idea theoretically representing it, extends further than its inventor originally anticipated, then we may be led by it to unexpected discoveries, of which conical refraction, circular polarisation by total reflexion, Hertz's waves offer ready examples, in contrast to the illustrations given above.

Our insight into the conditions indicated will be improved, perhaps, by contemplating the development of some theory or other more in detail. Let us consider a magnetised bar of steel by the side of a second unmagnetised bar, in all other respects the same. The second bar gives no indication of the presence of iron-filings; the first attracts them. Also, when the iron-filings are absent, we must think of the magnetised bar as in a different condition from that of the unmagnetised. For, that the mere presence of the iron-filings does not induce the phenomenon of attraction is proved by the second unmagnetised bar. The ingenuous man, who finds in his will, as his most familiar source of power, the best facilities for comparison, conceives a species of *spirit* in the magnet. The behavior of a warm body or of an *electrified* body suggests similar ideas. This is the point of view of the oldest theory, *fetishism*, which the inquirers of the early Middle Ages had not yet overcome, and which in its last vestiges, in the conception of forces, still flourishes in modern physics. We see, thus, the *dramatic* element need not be absent in a scientific description, any more than in a thrilling novel.

If, on subsequent examination, it be observed that a cold body, in contact with a hot body, warms itself, so to speak, *at the expense* of the hot body; further, that when the substances are the same, the cold body, which, let us say, has twice the mass of the other, gains only half the number of degrees of temperature that the other loses, a wholly new impression arises. The demoniac character of the event vanishes, for the supposed spirit acts not by caprice, but according to fixed laws. In its place, however, *instinctively* the notion of a *substance* is substituted, part of which flows over from the one body to the other, but the total

amount of which, representable by the sum of the products of the masses into the respective changes of temperature, remains constant. Black was the first to be *powerfully* struck with this resemblance of thermal processes to the motion of a substance, and under its guidance discovered the specific heat, the heat of fusion, and the heat of vaporisation of bodies. Gaining strength and fixity, however, from these successes, this notion of substance subsequently stood in the way of scientific advancement. It blinded the eyes of the successors of Black, and prevented them from seeing the manifest fact, which every savage knows, that heat is *produced* by friction. Fruitful as that notion was for Black, helpful as it still is to the learner to-day in Black's special field, permanent and universal validity as a *theory* it could never acquire. But what is essential, conceptually, in it, viz., the constancy of the product-sum above mentioned, retains its value and may be regarded as a *direct description* of Black's facts.

It stands to reason that those theories which push themselves forward unsought, instinctively, and wholly of their own accord, should have the greatest power, should carry our thoughts most with them, and exhibit the staunchest powers of self-preservation. On the other hand, it may also be observed that when critically scrutinised such theories are extremely apt to lose their cogency. We are constantly busied with "substance," its modes of action have stamped themselves indelibly upon our thoughts, our vividest and clearest reminiscences are associated with it. It should cause us no surprise, therefore, that Robert Mayer and Joule, who gave the final blow to Black's substantial conception of heat, should have re-introduced the same notion of substance in a more abstract and modified form and as applying to a much more extensive field.

Here, too, the psychological circumstances which impart to the new conception its power, lie clearly before us. By the unusual redness of the venous blood in tropical climates Mayer's attention is directed to the lessened expenditure of internal heat and to the proportionately lessened *consumption of material* by the human body in those climates. But as every effort of the human organism, including its mechanical work, is connected with the consumption of material, and as work by friction can engender heat, therefore heat and work appear in kind equivalent, and between them a proportional relation must subsist. Not *every* quantitative relation, but the appropriately calculated *sum* of the two, as connected with a proportionate consumption of material, appears *substantial*.

By exactly similar considerations, relative to the economy of the galvanic element, Joule arrived at his view; he found experimentally that the sum of the

heat evolved in the circuit, of the heat consumed in the combustion of the gas developed, of the electro-magnetic work of the current, properly calculated,—in short, the sum of all the effects of the battery,—is connected with a proportionate consumption of zinc. Accordingly, this sum itself has a substantial character.

Mayer was so absorbed with the view attained, that the indestructibility of *force*, in our phraseology *work*, appeared to him *a priori* evident. "The creation and annihilation of a force," he says, "lies without the province of human thought and power." Joule expressed himself to a similar effect: "It is manifestly absurd to suppose that the powers with which God has endowed matter can be destroyed." Strange to say, on the basis of such utterances, not Joule, but Mayer, was stamped as a metaphysician. We may be sure, however, that both men were merely giving expression, and that half-unconsciously, to a powerful *formal* need of the new simple view, and that both would have been extremely surprised if it had been proposed to them that their principle should be submitted to a philosophical congress or ecclesiastical synod for a decision upon its validity. But with all agreements, the attitude of these two men, in other respects, was totally different. Whilst Mayer represented this *formal* need with all the stupendous instinctive force of genius, we might say almost with the ardor of fanaticism, yet was withal not wanting in the conceptive ability to compute, prior to all other inquirers, the mechanical equivalent of heat from old physical constants long known and at the disposal of all, and so to set up for the new doctrine a programme embracing all physics and physiology; Joule, on the other hand, applied himself to the exact verification of the doctrine by beautifully conceived and masterfully executed experiments, extending over all departments of physics. Soon Helmholtz too attacked the problem, in a totally independent and characteristic manner. After the professional virtuosity with which this physicist grasped and disposed of all the points unsettled by Mayer's programme and more besides, what especially strikes us is the consummate critical lucidity of this young man of twenty-six years. In his exposition is wanting that vehemence and impetuosity which marked Mayer's. The principle of the conservation of energy is no self-evident or *a priori* proposition for him. What follows, on the assumption that that proposition obtains? In this hypothetical form, he subjugates his matter.

I must confess, I have always marvelled at the æsthetic and ethical taste of many of our contemporaries who have managed to fabricate out of this relation of things, odious national and personal questions, instead of praising the good fortune that made *several* such men work together and of rejoicing at the in-

structive diversity and idiosyncrasies of great minds so fraught with rich consequences for us.

We know that still another theoretical conception played a part in the development of the principle of energy, which Mayer held aloof from, namely, the conception that heat, as also the other physical processes, are due to motion. But once the principle of energy has been reached, these auxiliary and transitional theories discharge no essential function, and we may regard the principle, like that which Black gave, as a contribution to the *direct description* of a widely extended domain of facts.

It would appear from such considerations not only advisable, but even necessary, with all due recognition of the helpfulness of theoretic ideas in research, yet gradually, as the new facts grow familiar, to substitute for indirect description *direct* description, which contains nothing that is unessential and restricts itself absolutely to the abstract apprehension of facts. We might almost say, that the descriptive sciences, so called with a tincture of condescension, have, in respect of scientific character, outstripped the physical expositions lately in vogue. Of course, a virtue has been made of necessity here.

[TO BE CONCLUDED.]

JUST PUBLISHED:

The Gospel of Buddha

ACCORDING TO OLD RECORDS TOLD BY
PAUL CARUS.

With Table of References and Parallels, Glossary, and complete Index. Pages, xvi, 275. Elegantly bound, gilt top. Price, \$1.50.

The Open Court Publishing Company

THE OPEN COURT

"THE MONON," 324 DEARBORN STREET.

CHICAGO, ILLINOIS, Post Office Drawer F.

E. C. HEGELER, PUBLISHER.

DR. PAUL CARUS, EDITOR.

TERMS THROUGHOUT THE POSTAL UNION:

\$2.00 PER YEAR.

\$1.00 FOR SIX MONTHS.

N. B. Binding Cases for single yearly volumes of THE OPEN COURT will be supplied on order. Price, 75 cents each.

CONTENTS OF NO. 376.

| | |
|--|------|
| THE PILGRIMAGE OF ANTHONY FROUDE. Mon- | |
| CURE D. CONWAY | 4279 |
| HOLMES'S ANTI-DOGMAS. Dr. FELIX L. OSWALD... | 4280 |
| ON THE PRINCIPLE OF COMPARISON IN PHYS- | |
| ICS. PROF. ERNST MACH..... | 4283 |