concealed bell and so satisfy the passenger. This, by the employment of detectives, was soon stopped; but the ingenious conductors still managed to "keep ahead of the punch" by simply neglecting to use it when the cars, as is often the case, were so packed as to render close observation of their movements impossible. Several city car lines eventually abandoned the device for apparatus much more simple, to which we shall refer further on. Recently, however, another detection of bell-punch frauds has been made, and a regular conspiracy has been revealed between sundry ingenious scamps who showed the conductors how to pick the locks of their punches and set back the indicators, for the considera- of $1 per day, the conductor, of course, making up this amount and as much more as he safely could by theft.

There are various other devices analogous to the bell-punch now in use on our city car lines. None of them, however, punch slips. One is a metal box suspended in full view on the conductor's breast. On receiving a fare he is required to move a catch which sounds a bell and changes a number indicating the quantity of fares received, which appears on the front of the box. Another machine displays no number, but simply rings a bell and moves an indicator locked up inside. Some of these machines were constructed at first to register only a certain number of fares, say 1,000, and then to return to the naught point. The conductors soon discovered this, and after collecting the money they would ring the bell up to its limit, help themselves to the amount of money they wished, and then register anew fares to correspond with the amount they left for their employers.

It will be observed that the tendency of all these machines is to make the passenger a policeman over the conductor to keep him in the path of rectitude, and it is curious to notice that the more of these devices there are invented the more is this duty imposed upon the passenger. The largest street railroad line in this city, that on Third Avenue, has abandoned the bell-punch for a simple dial in the car, with which is connected a square rod which traverses the length of the vehicle near the roof. In order to turn this rod, and so sound the bell and move the index, which the conductor is required to do on the receipt of each fare, a wrench must be used, and, of course, the arm lifted high above the head. This compels the conductor to take a noticeable position, and as the rod is accessible only while he is on the vehicle, the conductor can not, as with the bell-punch or other portable device, pretend to register fares while temporarily off his car. The movement of the dial hand attracts attention, and thus the watchfulness of the passenger is still further enlisted.

There are two devices, however, which advance considerable further in this same direction. One is the fare-box, by the use of which the railroad company tacitly asserts that it prefers to trust to the honesty of the public in general than to that of its employees, and the other is a most ingenious apparatus, of which we shall presently speak, and which literally compels the passenger to look after the employees in order to keep himself from being swindled.

The fare-box is, however, fast becoming a bone of contention. It is simply a box into which the passenger is invited to place the correct fare. The driver—there is no conductor in such cases—is not allowed to receive or put in money, and the extent of his pecuniary duty consists in handing back change for small bills, said change being previously sealed up in envelopes, and as the driver aforesaid has always to return the amount he starts out with, he cannot conveniently steal any. When the passenger puts in his money the driver can see and count it, and that done he moves a slide which dumps it into a locked box below, whence it is removed by an official at the terminus. The box, we have stated, is a source of aggravation to the sovereign public, first, because one set of unthinking individuals are constantly throwing in too much and clamoring for change after the money is engulfed in the locked receptacle, when removal is impossible, and second, because perverse people decline to be ordered to do anything by the railroad company and demand that if their fares are wanted somebody must come and get them. The latter have multiplied of late, and are vigorously asserting themselves. The driver cannot take the fare, and if the passenger refuses to comply with the rules, that passenger must be put off the car. The passenger resists and a disturbance results, the upshot of which may be to block the line, and, as was the case here recently, keep some 200 other passengers in rear cars waiting a considerable time.

By far the most ingenious of all these devices is that devised for use on city cabs. There is a metal circular case on the face of which are two concentric circles. The inner one is marked as a clock, the other is divided decimally to indicate dollars and cents. The hands on the inner circle are controlled by clockwork, that on the outer circle must be moved by the driver. From one side of the clock extend wire rods on which is a sign with the words "to hire." Between the rods is a watch. The whole is pivoted on the cab just in rear of the driver's seat, and in such a manner that when the "to hire" sign is turned uppermost it stands above the roof and is plainly visible. In face of the passenger in the cab is an opening through which the watch is seen when the sign is turned down.

If, when the cab is hired, the driver does not turn down the sign, the passenger will demand it, because otherwise the watch cannot be seen, and by this watch the time for which the cab is used and paid for is determined. But the action of turning down the sign starts the clock, and this then goes on registering hours and minutes. When the passenger leaves the vehicle he pays his fare, and this the driver registers on the dial bell-punch fashion. The driver must then turn his sign up. If he does not, the clock will continue running, and he will have to pay for the time himself at the regular tariff of 50 cents per hour. So from the two dials at the end of the day the inspector sees just how long the cab has been used and the amount collected. On the back of the clock is still another dial, on which is an index which moves over one division every time the sign is turned down. This shows the total number of trips, and is locked so that the driver has no access to it. It prevents the driver charging for trips only a fraction of an hour in duration as for a full hour. It will be seen, therefore, that by noting the trips and number of hours employed, the inspector can at once calculate the amount which the driver owes.

It is difficult to see how such a device as this can be defrauded. The objection to it is its inapplicability of such conveyances as stages and street cars; and for these vehicles some device which shall absolutely ensure the honesty of their conductors or drivers is still a necessity. We commend the subject to inventors as a promising one for their efforts. Only let them remember that, however ingenious they may be, ingenuity as sharp as theirs will probably be brought to bear to circumvent their apparatus. Perhaps the safest rule to go by is to try to contrive a device which shall, like some of those wonderful intricate locks, be impracticable of access or alteration even to the inventor himself.

FOOD.

In discussing, last week, the subject of how shall working men live, we quoted a table prepared by a working man's wife, showing a list of necessaries on which her husband, herself, and five children (under 9 years of age) subsist. This category, which is claimed to represent the cheapest and most economical living attainable by the compiler, we here republish, as we propose to use it as a text for some further remarks.

WEEKLY.		DAILY.	
Rent	$2 00	1 quart milk, 6c	$ 42
1 barrel wood	25	2 quarts potatoes, 6c	42
2 pails coal	16	2 8-cent loaves	1 12
Burial society	22	1½ pounds meat, 20c	1 40
Oatmeal	14	Salt	2
2 pounds butter	60	Pepper	2
3½ pounds sugar	40	Mustard	2
Half gallon oil	9	Matches	1
2 cakes soap	14	Starch	3
1 pound soda	3	Bluing	1
Half pound tea	25		
Newspapers	12	Total	$3 47
Shaving	10		4 50
Total	$4 50	Total	$7 97

It will be observed that this, among other things, is intended virtually as a practical answer to the question as to the minimum amount of food on which a family of presumably average size and weight can live without detriment to health. The ultimate destiny of food is, to quote Dr. Wilson of Edinburgh, "the development of heat and other modes of motion, which together constitute the physiological phenomena of animal life." Food not only, however, supplies potential energy—which becomes converted into actual or dynamic energy—but it supplies the material for the development of the body. Hence inorganic and organic matters are both necessary, the latter, however, being alone oxidizable or capable of generating force. The organic constituents are divided into nitrogenous, fatty, and saccharine compounds—the inorganic into water and saline matters. Of these the nitrogenous portion constructs and repairs the tissues, it is the muscle and brain producer; the carbonaceous portion goes to maintain animal heat, aids the conversion of food into tissue, generates fat, etc.; the saccharine portion has heat-producing powers inferior to the fatty constituents, and finally the water and saline matters dissolve and convey food to different parts of the system, consolidate tissues, remove effete products, etc. In general, however, the phenomena of nutrition depend mainly on the chemical interchanges of nitrogen and carbon with oxygen, and therefore different articles of diet are estimated in nutritive value according to the amount of nitrogen and carbon they contain.

Dr. Letheby, in his valuable work on "Food," gives a table showing the amount of carbon and of nitrogen in a large number of articles of diet. From this table we have taken the values of the varieties of food in the above list, and we find that the sum total of the entire regimen amounts to 18,117 grains of carbon and 751 grains of nitrogen daily. According to Dr. Wilson, the dietaries of women should be about one tenth less than those of men, and of children under ten years about one half (maximum) those of women. Applying these rations to the aggregate, we find that the husband's daily diet is 4365 grains of carbon and 180 grains of nitrogen; and the wife's 3928 grains of carbon and 162 grains of nitrogen, and the remainder constitutes the food of the children.

Now this diet is not enough to support life in the husband and to enable him to work. In other words, we mean to say that a man that attempts to do even moderately hard work on food containing the proportions we have mentioned, is steadily falling behind in the struggle for existence. And it is mathematically obvious that he cannot improve matters save at the expense of other lives. From the mean of all the researches which have been made by eminent physiologists—and they cover thousands of instances—Dr. Letheby gives the following as the amounts required daily by an adult man for idleness, for ordinary labor, and for active labor:

	Carbon grs.	Nitrogen grs.
Idleness	3816	180
Ordinary labor	5688	307
Active labor	6823	139

Compare these figures with those quoted, and it will be seen that the nitrogenous products in the latter are just equal to the requirements of an idle man, and far below those of one at work, while the carbonaceous products—which do not form muscle—are somewhat in excess in one case, and too low in the other. But a better idea of the comparative nature of diets can be obtained from some of the following instances of the dietaries of low fed and well fed operatives in England, which we take from the tables of Drs. E. Smith and Playfair.

The mean of twelve classes of low fed operatives, which include the farm laborers and weavers over the different sections of the kingdom, shows an average daily dietary of carbon 4881, and nitrogen 214. These are about the worst fed people in England. The staple of diet is breadstuffs, and then potatoes—not a class on the list gets more than 18·3 ozs. of meat in a week—yet the average of all is above that of the American workman. Let us examine, however, some instances of well fed operatives. The English railway navvy (whose class corresponds to that of the workman under consideration) has 8295 grains of carbon, and 482 of nitrogen; the blacksmith, 6864 carbon, 437 nitrogen; soldiers in peace, 5246 carbon, 297 nitrogen; prize fighters (training) 4366 carbon, and 690 nitrogen. The mean of eleven classes of well fed operatives is carbon 5837, nitrogen 400.

The trouble with the diets of our working men is not in their cost, but, as in the present case, in their bad selection. Here are 5½ lbs. of food (butter and sugar) which together aggregate 23234 grains of carbon and no nitrogen, at a cost of one dollar per week. The butter could be altogether abolished, and the sugar reduced one half; the eighty cents so saved could be laid out in Indian meal, or dried peas, beans, rice, barley meal or fish, all of which contain large proportions of nitrogen. A pound of red herrings, costing say 10 cents, contains 217 grains of nitrogen; a pound of skim cheese at the same price contains 485 grains; split peas, worth about 8 cents a quart, contain carbon 2699, nitrogen 248; beef liver, always cheaper than beef, contains carbon 934, nitrogen 204, while beef itself contains carbon 1854, nitrogen 184.

It may be said that working men cannot be expected to consider chemically everything they eat. Perhaps not, but it is the duty of sanitary authorities, and others charged their welfare, to do it for them. Half a pound of cheese, a pound of Indian meal, and a quart of milk, together aggregating 5187 carbon, and 449 nitrogen, cost 14 cents. On this a man could do steady work for one day, and could keep on on the same diet continuously. The same sum would purchase one loaf of bread and a quarter of a pound of butter, on which, as a continuous diet, a man could not subsist. For the guidance of working men who wish to base their living on proper and cheap food, we give herewith Dr. Letheby's table:

	Grs. per lb. Carbon.	Nitrogen.		Grs. per lb. Carbon.	Nitrogen.
Split peas	2699	248	Skimmed milk	438	43
Indian meal	3016	120	New milk	599	44
Barley meal	2563	68	Skim cheese	1947	483
Rye meal	2693	86	Bullock's liver	934	204
Seconds flour	2700	116	Mutton	1900	189
Oatmeal	2831	136	Beef	1854	184
Baker's bread	1975	88	Fat pork	4113	106
Pearl barley	2660	91	Dry bacon	5987	95
Rice	2732	68	Green bacon	5426	76
Potatoes	769	22	White fish	871	195
Turnips	263	13	Red herrings	1435	217
Green vegetables	420	14	Suet	4710	—
Carrots	508	14	Lard	4819	
Parsnips	554	12	Salt butter	4585	—
Sugar	2955	—	Fresh butter	6456	
Molasses	2395		Cocoa	3934	140
Buttermilk	387	44	Beer	274	1
Whey	154	13			

The American Institute Exhibition.

It will not be the fault of this paper if the coming exhibition of this Institute should prove to be a chaotic mass of half arranged merchandise on the opening day (September 12), for we have so often given notice of the fact that an exhibition is to be held, and have as repeatedly given notice of the time; nor will it be the fault of the officers of the Institute, for the building is always ready in time; but will, we presume, be the fault of the exhibitor, who, as a general rule, procrastinates, and is often many days behind. We should think that, if an exhibition is worth attending at all, that the exhibitor would desire that his exhibit should be arranged upon the opening day, and not a week or ten days later. For information address General Superintendent, room 22, Cooper Union Building, New York.

A Remarkable Railway Bridge.

The new iron railway bridge over the river Douro, near Porto, Portugal, crosses it with an arch of a single span which measures 160 meters (520 feet) and has a rise of 42 meters (138 feet 6 inches). It is crescent-shaped in form; that is, the extrados and the intrados, which are connected by struts in the form of St. Andrew's cross, are farthest apart at the crown.

MANUFACTURE OF EBURINE.—Eburine is a composition formed from the dust of ivory or bone cemented together with gum tragacanth or albumen, and colored at pleasure. In some cases pressure and heat render the addition of any glutinous matter unnecessary.

A NUBIAN TEMPLE.—The temple of Ypsambul, in Nubia, is cut out of a solid rock, and is of vast dimensions. In it are four colossal figures sixty-five feet high, twenty-five feet across the shoulders, with faces seven feet high, and ears about a yard long.