On the extravagant use of fuel in cooking operations : with a short account of Bejamin Count of Rumford, and his economical systems and numerous practical suggestions adapted for domestic use / by Frederick Edwards, jun.

FUEL IN COOKING.

EDWARDS.

ON THE

EXTRAVAGANT USE OF FUEL

IN COOKING OPERATIONS,

WITH

A SHORT ACCOUNT OF BENJAMIN COUNT OF RUMFORD, AND HIS ECONOMICAL SYSTEMS,

AND

NUMEROUS PRACTICAL SUGGESTIONS ADAPTED FOR DOMESTIC USE.

BY

FREDERICK EDWARDS, JUN.

AUTHOR OF "OUR DOMESTIC FIRE-PLACES," "A TREATISE ON THE VENTILATION OF DWELLING HOUSES," &c.

LONDON:

LONGMANS, GREEN & CO., PATERNOSTER ROW.

1869.

LONDON:

PRINTED BY J. DAVY AND SONS, 137, LONG ACRE.

CONTENTS.

Description to Plates.

PREFACE.

Is this an opportune time for inviting public attention to the great waste of fuel in kitchen fire-places? The writer may reasonably be excused for suggesting the question. Nearly five years ago he issued his first little essay—one that related to the construction of fire-grates. He had labored in the hope and expectation that it would be of extensive service, and that he might be encouraged so to persevere in his efforts as to be able within a few years to initiate and largely effect a substantial reform in the general use of coal for domestic purposes. The writer has persevered in his efforts, and in contemplating their result at the present period, he cannot disguise from himself that if he has some reason to be gratified he has also much reason to be disappointed. He has had on the one hand many complimentary notices from the press. He believes he may justly say that he has received substantial support wherever any careful attention has been paid to his books, and his publications have sold. But, on the other hand, the public journals have not generally taken up the questions he has brought forward in the only way that can be effectual for exciting public attention. His subject has but crept imperceptibly along. He has had no wind to fill his sails, and all that he has really gained is the right

to expect an increased amount of attention in any repetition of his efforts.

The writer cannot but feel that if he has not succeeded in exciting a due amount of attention, this is owing in a large measure to the scanty support which the press are in the habit of giving to those who write books which may be supposed to be useful rather than interesting or amusing. He has no wish to complain of the press. He believes it to be conducted, on the whole, with remarkable fairness and ability; but he is not without a suspicion that editors, like other mortals, are disposed to keep a little too long to the grooves they are accustomed to move in, and that, like Cabinet ministers, they can just bear to be made susceptible to the occasional presence of the "flapper" who takes upon himself to awaken their attention to some question of public moment. He knows tolerably well what must be the exigencies of journalism, but he would submit to the conductors of several leading papers whether it is not desirable that well-meant and earnest efforts for the public good should meet with the amount of recognition which may render it a pleasure to their originator to pursue them. At present a new average book of travels, an average novel or biography appears, and it receives general and prominent notice, but the more purely useful book is very often passed over altogether; and if the writer may instance his own case, he will state frankly that, though favorably circumstanced for exciting confidence, and though he has expended the time in condensing which some writers employ to expand, his labors have been simply onerous, and that if he had not reason to expect a very much larger amount of attention in the future than he has had hitherto, he could not for a moment hesitate to abandon his subject altogether, and leave it for a more favorable period and a better qualified

hand. Possibly some may be disposed to say that the writer has fared as well as the average of authors, and that he is disposed to be too exacting. He can only reply by asking of what earthly use it can be for him to issue a book that, like a footstep on the shore, is visible one day, and gone the next. Either he really succeeds in exciting public attention, and gains a chance of effecting a reform, or his labor is practically thrown away.

If the importance of the subject of the waste of fuel in kitchens—worse there probably than in any other case—be for a moment considered, together with the fact that no one has appeared to discuss it since the issue of Count Rumford's essays some seventy years ago, the author ought not to be able to doubt that his present essay will receive a reasonable amount of attention, and there are happily other grounds for believing that the present time is not probably an inopportune one for bringing forward any subject of general utility. National prosperity is flagging a little. The thousands of collapsed schemes for making money rapidly may probably work a good by reawakening a regard for the trustworthy means by which money is to be made or saved. Intelligent readers are satiated or disgusted with the sensational school in literature. All sorts of public questions begin to look as if they might rapidly occupy a most prominent position, and it may therefore be not unreasonable to conclude that the author has but to persevere and he will inevitably succeed in obtaining the amount of careful consideration which he may really be entitled to expect.

In his present essay, the author has followed his practice of doing his best to make his subject interesting. He avoids the amount of detail which would make his book technical and wearisome, but he introduces as much as appears to him to be really necessary to make the subject

understood. It is impossible for any one who makes the slightest examination not to see what an enormous deal may be effected, and this not by casting about for any thing entirely new in the way of invention, but solely by a systematic and energetic application of means that are within the command of every one who is sufficiently industrious to search for and apply them, a mode of treatment that would work a transformation in other matters than the use of coal in kitchen fire-places. We are now recklessly, almost criminally, extravagant. Other nations are not so. The causes are not far to seek. Only let us resolutely reduce the heat radiated to waste in the kitchen apartment, and the hot air sent rapidly away up the chimney, and the whole state of things becomes changed. Consumption may easily be reduced to a half, a third, or even a fourth. Count Rumford reduced it to less than a fifth; and if in the face of such a fact we have gone on in our extravagant habits, this is simply because the difficulties which have to be encountered are altogether of another nature than those which concern the public exposition of an improved system, and of the advantages attending it.

Many may suppose that a manufacturer has it completely within his power to bring an improved system into use. They are most entirely mistaken. A manufacturer has undoubtedly certain advantages over less interested persons. He is probably more practically familiar with his subject, and he may be stimulated to higher exertions by the hope of improving his business; but that it is really a profitable thing for a manufacturer to seek to improve on existing practice is almost invariably belied by facts. To bring about a change in any matter, there are generally years of uphill work, in which money has to be sunk instead of being made, and this does not suit the keen-sighted man of business. If this were not so, if it really

had been a profitable thing for men to study the subject of improvements, the present writer would never have had to urge his questions upon the public. He would long since have been anticipated. It certainly ought not to be so. It is to be hoped that the difficulties which attend the introduction of improvements will gradually diminish; but, as matters stand at present, it is an unquestionable fact that successful tradesmen do not generally care about improvements. They find it sufficient to be on the look out to observe which way the wind is blowing. A person who relies upon his skill has not a chance, and the one most suitable to initiate a reform is either such a man as Count Rumford, who from deliberate choice devoted himself gratuitously with that object, or the manufacturer who makes himself specially conversant, who, happily, independent of such means for his subsistence, feels a pleasure in devoting himself to those questions of general utility which may afford him the readiest opportunity of proving useful, and who can afford to exercise, with some sort of philosophical resignation, the patience which is necessary for effecting a slight change for the better in any portion of the world's affairs.

49, *Great Marlborough Street*,
London, *February* 16, 1869.

CHAPTER I.

A short Account of Benjamin Count of Rumford, and a Description of his Methods of economising Fuel used in the Preparation of Food.

Many millions of pounds sterling are spent yearly in these islands on the fuel used in kitchen fire-places. The cost forms an important item in the expenditure of most householders; but so much has the subject of economising the fuel been neglected, that we cannot be considered practically to have made any great advance on the methods used by our ancestors centuries ago. They made a huge fire on the hearth, suspended a vessel above, and roasted a joint in front. The greater proportion of the heat was of course radiated to waste, or escaped by the chimney; and in our modern contrivance, in what may be termed a very symbol of extravagance—an English kitchen range, we furnish the like evidence of an amount of heat being developed altogether out of proportion to that which can possibly be turned to account. In the more modern "kitchener" the cooking conveniences are greater; but the amount of heat radiated to waste in the apartment, or allowed to escape by the flues, is no less conspicuous than in the open kitchen range.

Now, in other countries, generally speaking, there is not this extravagance. Wealth is not so abundant. Coal is there dearer. It is treated as if it were an article of value,

not to be squandered, and the conveniences which are provided for using it are consequently such as to render our reckless waste absolutely impossible. We have indeed had instruction very near at hand; and if we have not hitherto profited by it, and have offered no encouragement to any one desirous of reforming our habits, this has probably arisen from a want of interest on a subject that is not understood, and from our extreme unreadiness to emancipate ourselves from a custom which a long course of years, or which centuries have engrained.

It is very satisfactory to remark that there has been one diligent worker who, familiar with the practice of other countries, and having unusual opportunities of experimenting during many years in the preparation of food for large numbers of persons, applied himself with unwearied industry in the attempt to introduce improved methods, both here and abroad, and who left in his admirable essays the most clear and complete information relating to the most important of his experiments, and to the means he ultimately found to be most effectual. This was one whom Gibbon called "the soldier, philosopher, and statesman, Thompson," but who will be remembered as the economist, philanthropist, and man of science, Benjamin Thompson, Count of Rumford. In Munich, Count Rumford was able to prepare a substantial soup dinner for a thousand poor persons at a cost of fourpence-halfpenny for fuel. His plans were carried out, to some extent, in other parts of Bavaria, in England, in Scotland, in Ireland, and in Italy. He found by his investigations that nine-tenths of the fuel commonly used in public and private kitchens could be saved, and this not by impairing in the slightest degree any excellence which had been attained in cooking—for on this point Count Rumford was fastidious—but solely by cutting off every source of waste,

and applying with great care the heat which he actually used. The Count's career was so remarkable and interesting, that a short account of it, and of the circumstances which led him to become so familiar with the question of economising fuel in cooking, can only serve to enhance whatever interest may attach to his very useful investigations and suggestions.

Benjamin Thompson was a native of a district called Rumford, in the province of New Hampshire, in the United States. Misfortune attended his early years, and he was indebted to a benevolent clergyman for a sound education, which included instruction in science. Preferring science to commerce, his prospects were gloomy; but a happy marriage gave him a comfortable home and a competence. Soon after, the war of Independence broke out. Thompson became actively engaged on the side of the Crown. His wife gave him a daughter at the cost of her life; and when the English troops evacuated Boston, Thompson was selected to carry this news to the English Government in London. His good countenance, and the extent and exactness of his information, so pleased Lord Sackville, that he secured Thompson's services in his own department; and Thompson rapidly rose by means of unflinching industry and fidelity to the position of Under Secretary of State. During his stay in London he cultivated science with ardor, as he had done in America, and read certain papers to the Royal Society, which procured him admission to that body. The Ministers fell into disgrace. Thompson resigned his position, and returned to America. He reorganized the cavalry, and was sent subsequently to Jamaica; but peace came, and restored him, with the title of colonel, to an inactive life. Longing for a definite career, he came over again to Europe with the design of utilizing his knowledge in the service of the

Emperor of Austria against the Turks; but becoming acquainted with Prince Maximilian of Bavaria, and his uncle the reigning elector, the latter sought his assistance in arranging his military affairs. The colonel willingly consented. Permission was accorded from England with the title of knight and a pension. He rapidly rose in the confidence of the elector, who advanced him by degrees till he became councillor of state and lieutenant-general of his army, and who finished by giving over to him the administration of the war department and the charge of the police. It was amid scenes of administrative labors that Thompson's attention became drawn to the question of preparing wholesome food in considerable quantities at the smallest cost, and his untiring industry and inventiveness found full scope for development.

He reorganized the army. He made changes in uniform, in armor, and in artillery. He simplified exercises and manœuvres. He facilitated advance from the lower ranks. He raised the soldier's pay, and succeeded in making him contented with his lot. He established schools of industry and schools of instruction for the soldiers, for their children, and for the children of neighboring peasants; and thinking that soldiers should actually be of benefit in times of peace, and that it was not derogatory to their character to engage in public works, he employed them in making and repairing roads, in draining marshes, and repairing banks of rivers. He thought soldiers should be citizens and citizens soldiers, and promoted this object by every means in his power, particularly by establishing permanent garrisons. After reforming the army he employed it as a police force for the purpose of eradicating one of the greatest evils with which a country can be afflicted—that of mendicity. At that period indolence, destitution, and beggary were said

to prevail in almost all the countries of Europe. In Bavaria, the number of professional beggars was very great, and in Munich a regular traffic was carried on with the food which was collected by them, and sold afterwards for the use of the poor; but, what was perhaps worse, very few of the lower classes were free from the practice of begging. Sir Benjamin Thompson held the noble-minded belief that men are rather weak than wicked. He had little faith in raising a degraded people by merely preaching to them the happiness of a life of virtue. He thought if he could but succeed in making them happy, virtue would follow; and therefore the measures he adopted were most humane, but nevertheless firm. He began in Munich. On New Year's Day, 1790, when the beggars were all abroad, he assembled the field officers and chief magistrates at his lodgings; he acquainted them with his plans, and obtained the promise of their assistance. They sallied forth together. Sir Benjamin Thompson set the example by arresting the first beggar, who was handed over to a guard with orders to conduct him to the Town Hall, there to give certain particulars concerning himself, upon which he was set at liberty, after receiving instructions to repair the next day to the Military Workhouse, where work, such as he might be fit for, would be provided him. The officers and magistrates so heartily co-operated that in less than an hour no beggars were seen abroad in Munich. Patrols were rewarded for every beggar they arrested. Addresses were issued to the inhabitants praying them to discountenance beggary. The names of two thousand six hundred professional beggars and indigent poor were entered on the books in one week, and Sir Benjamin Thompson proceeded forthwith to put his inventiveness in practice for dealing effectively with such a mass of ignorance and destitution. The Military Work-

house was a place where clothing was prepared for the army. It was a large and commodious building, well warmed and lighted, and particularly well adapted for the purpose Sir Benjamin Thompson intended, viz., to furnish work for the destitute, and to train up the poor and the children of the poor to the knowledge of some handicraft and to habits of industry. Thousands of spinning wheels, supplies of material and utensils of various kinds, together with suitable instruction, were obtained. Generous pay and kind usage met with great success. Every effort was used to excite emulation. A warm soup dinner was provided daily, and the clothing of the army became provided for under the new system. Three thousand florins were lost by it during the first quarter, but this was cheaper than beggary.

For the children of the poor and for others who desired it, gratuitous instruction in reading and writing was provided, and, for the infirm poor or those temporarily disabled, a system in every district was organised for dispensing by the aid of volunteers in whom the public could confide, gratuitous assistance in the shape of food, money, or medical advice.

Sir Benjamin Thompson, had to provide food for his multitude, and never possibly was there a man more fitted as an economist to furnish excellent nourishment, at the smallest possible cost. In winter, about twelve hundred were present to dine in his "House of Industry;" in summer, sometimes fifteen hundred, and a considerable number more had to be provided for out of doors. Sir Benjamin turned his attention very forcibly to the preparation of economical soups, and succeeded in providing for each person, a pound and a quarter of good soup, composed chiefly of barley and peas, mixed with cuttings of fine white bread, and properly seasoned, at the cost of

a penny, including the cost of the fuel and the cookmaids' attendance.* A piece of good rye bread weighing seven ounces was given to each person in addition to the soup. It was computed that the same soup would cost in London, two and three quarter farthings for each person, but in Munich, it became reduced in cost to a farthing, by the use of the potato, a plant which Sir Benjamin Thompson introduced in Bavaria, in spite of great prejudice. Further arrangements consisted in roasting meat for two hundred persons daily; in instructing the poor how to prepare economical and wholesome food, and in collecting from tradesmen in the town, and others, the contributions they had been in the habit of giving to mendicants, but which were now put aside to be delivered daily to the collectors from the new "House of Industry and Institute for the Poor," sixteen small carts having been specially prepared for this particular business.

It was, in carrying out these admirable arrangements, that Sir Benjamin Thompson was first led to give systematic attention to the economical employment of heat for the purposes of cooking. He made experiments, trials, and alterations, until he succeeded in pushing economy nearly as far as he concluded it was possible to go, and this, for such a man, meant a great deal. The appliances for cooking which he erected were taken down, altered, and entirely rebuilt three times, with the ultimate benefit that the fuel used cost no more than *one* per cent. of the cost of the food. The fact, that a thousand persons were

* Full particulars of the composition and cost of these soups is given in Count Rumford's earlier Essays.

"C'est donc à Rumford que l'on doit le premier établissement des soupes économiques ainsi que celui des foyers qui portent son nom; et cette double découverte doit rendre à jamais sa mémoire chère à tous les amis de l'humanité."—*Biographie Universelle.*

provided with the soup dinner at a cost of four-pence half-penny for fuel, was vouched for by a certificate from certain persons in authority for the satisfaction of the incredulous.* For boiling water, eight large copper boilers were provided, each of which contained thirty-eight gallons, and were heated by one fire, the smoke and heat being made to pass by certain ramifications of flues, and to come perpetually in contact with the boilers, so that the currents of hot air were tolerably well exhausted of the heat they contained before their final escape. Much of the heat and of the hot vapor or steam, which had been generally wasted, were now used to warm water in readiness for the next day's supply, and to dry the wood used as fuel.

Great as was the economy he effected, Sir Benjamin Thompson carried it subsequently yet further at the Hospital of La Pietà, in Verona, but his experience informed him, that he could not depend upon others to carry out his instructions, with the intelligent care he knew to be necessary, and he therefore contented himself with laying down the injunction, that the cost of the fuel should not exceed two per cent. of the cost of the food. In many other cases, the same contrivances or

* Certificate relative to the expense of fuel in the Public Kitchen of the Military Workhouse at Munich :—

"We, whose names are underwritten, certify that we have been present frequently, when experiments have been made to determine the expense of Fuel in cooking for the poor in the Public Kitchen of the Military Workhouse at Munich; and that when the ordinary dinner has been prepared for one thousand persons, the expense of Fuel has not amounted to quite twelve cruitzers (less than 4½d. sterling).

"Baron de Thibout, Colonel,

"*Munich, 1st September*, 1795.

"Heerden, Councillor of War."

ameliorations were executed, and the unremitting inventor desiring to extend as widely as possible, the benefits of his experience and teaching sought to carry out his combined systems of providing food, employment, and instruction for the poor throughout Bavaria, and he proposed with the same machinery to afford facilities for introducing and bringing forward all new inventions and improvements for promoting domestic comfort and economy, particularly such as related to the management of heat and the saving of fuel.

However much Sir Benjamin Thompson was fitted to be the model minister of a model king, he did not for his own peace find everybody sufficiently docile. Many became tired probably of his pertinacious inventiveness, and however conciliatory might be his behavior, he could not help giving in his essays some vague hints of the opposition he had encountered. An institution he set on foot for the purpose of giving gratuitous instruction of a superior character to a select number of children of humble station, that their "native genius" might have suitable opportunity for development, he particularly feared would not be allowed to subsist. But, whatever were the feelings which his rise, position and possibly inconvenient industry may have excited in some, the extreme consideration he had always shown for the classes he benefited won for him their affectionate regard. He relates, for the purpose of assuaging his disappointment, how, when he was lying dangerously ill at Munich, "worn out by intense application, and dying, as everybody thought, a martyr in the cause to which he had devoted himself," he heard a confused noise in the street, and on inquiring the cause, was told that it was the poor of Munich, who, many hundreds in number, were going in procession to the church to put up prayers for him, "a private person, or stranger, a

Protestant," and how, five years later, when he was lying dangerously ill at Naples, a number of the poor set apart, of their own accord, an hour each evening to pray for him, after they had finished their work at the Military Workhouse; and further, how, after an absence of fifteen months, he gave a fête in the English garden to eighteen hundred poor persons, at which thirty thousand of the inhabitants of Munich were said to have been present. Soon after this last event he was created a Count, the name to his title being taken from the remote province of his birth. In 1796, he had the difficulty of maintaining peace when Europe was all in arms, and two years later he was deputed ambassador to London. This position, it was found, could not be held by a British subject, and his friend and benefactor, the elector, dying just at that period, Count Rumford foresaw what his altered position would be in the Bavarian Court, and he returned to Munich only to arrange certain private and public affairs. He then settled in London for some years, with the express object of publishing his essays and introducing the economical methods of preparing food, with which he had become so familiar during his singular investigations and experience. His connection with the Royal Society and the Royal Institution gave him opportunities to read papers relating to his researches, and influence and authority for introducing his novel schemes. He published essays relating to his different undertakings at Munich, and soon introduced his arrangements for cooking at the Foundling Hospital, where he succeeded in roasting a hundred and twelve pounds of meat in ovens at a cost of fourpence. He also introduced them in the kitchen of the Royal Institution, and in the Heriot Hospital, Edinburgh. His successes in this country, however, chiefly concerned the management of fuel in private dwellings.

Against the old English kitchen range, he set himself most strongly, remarking that more fuel was frequently consumed in it to boil a tea-kettle than with proper management would suffice to cook a dinner for fifty men, and he proposed therefore to substitute for our national mode of roasting, a system of cooking joints in ovens, which he had perfected in Bavaria. This system he considered to furnish a superior means of roasting, irrespective of the question of economy, and he overcame prejudice sufficiently to introduce several hundreds of his roasters for private use. They have now long been forgotten, but the system he adopted has been revived of late years, and become used in all the modern kitcheners, though hardly a person is to be found who knows that Count Rumford was its originator. The Count introduced many articles of striking utility for cooking by the poor, and he particularly turned his attention to the improvement of the large open fire-places, uncomfortable for warmth and prolific in smoke, which were then universal in this country. One of his essays was devoted to this subject, and it was upon this that he naturally met with the fullest success. In the kitchen he had to argue in favour of economy and scientific methods, and found few that took any intelligent interest; but in the question of warming apartments, personal comfort was concerned, and the Count gained assistance in his efforts from the smoke and want of warmth with which his listeners or readers were often unpleasantly familiar. Though he took no patents for his contrivances, and his efforts were entirely gratuitous, he found great difficulty in exciting any public interest, which caused him great disappointment. He paid a visit to Ireland, where he was cordially received, and he could not help contrasting the fact with the indifference his propositions met with in a certain wealthier country.

When he had completed the publication of his essays, Count Rumford, desirous of rest from his arduous labors, went to reside in France. He travelled in Switzerland and Italy in company of the widow of the celebrated Lavoisier, whom he subsequently married, and formed his residence at Auteuil, near to Paris. The union is said not to have been a fortunate one, and to have ended in a separation. The Count remained at Auteuil, receiving only certain particular scientific friends who belonged to the French Academy, of which body he was an Associate; and in 1814 he died, rather suddenly, at the age of sixty. His attached friend, Cuvier, then secretary to the Academy, rendered him the eulogistic honor paid by that body on the decease of a member.

It has been said that Rumford was influenced in his labors rather by the calculations of the able administrator than by the sympathies of the philanthropist,* and that his preferences were for a country like China, where the people are governed by the learned; but that this judgment is not trustworthy is evident enough from his essays, where the true nature of the man reveals itself in the most unmistakable manner. That he was an able administrator is undoubtedly true, and it is equally true that he was not an unreasoning philanthropist, but that the man who could devote himself for years to ameliorate the condition of the lower classes, and who could effect all that he did without permitting anything but kind treatment, not even the slightest chastisement of a child, and who could turn from the scientific researches of the study

* "Rumford a fait beaucoup de bien aux hommes, mais ce fut sans les aimer et sans les estimer. Dirigé dans ses opérations plutôt par les calculs d'un administrateur que par les mouvements d'un philanthrope, il jugeait les hommes comme un planteur juge les esclaves."—*Biographie Universelle.* Never surely was judgment more at fault.

and the laboratory, for which he proved himself to be eminently fitted, to labor without recompense at the poor drudgery of attempting to introduce the most economical methods of preparing food, was not as conspicuous a philanthropist as an administrator would appear to be contradictory, if all doubt were not set at rest by the evidence which his essays furnish that he was influenced by intense sympathy with humanity and deep religious feelings. Rumford's manners were simple. He only drank water. He never took boiled meat, considering it less nourishing than roast. He was like most hard workers, not a man of many words, and he always spoke to the point, but in his essays, which are admirably clear, he spared no words that could assist in making his teachings understood and appreciated by any persons whatever into whose hands they might fall. Rumford will be long remembered for his useful and long-continued labors in the interest of domestic economy, and the more especially because some of his suggestions may yet be received and become generally adopted. A statue was raised to his memory at Munich, and his likeness was often engraved;* but a worthier memorial of him remains in the gold medals which he himself founded both here and in America to encourage researches in heat and light.

Count Rumford's system of applying Heat for Cooking.

The great economy in the use of heat, which was effected by Count Rumford, was simply due to the fact that he acted on the sensible principle of not producing heat unless it was really required, of producing no more than

* An engraved likeness is to be seen at the Patent Museum, South Kensington. The facts here recorded are gathered chiefly from a study of his essays, and from the Biographie Universelle and Chalmers's Biographical Dictionary.

was required for the specific purpose in hand, that he strictly avoided any loss of heat by radiation into the apartment, and that he turned the heat to the fullest possible account before it could escape to the chimney. It must not be supposed that he dealt with the subject in any penurious spirit. He was too large-minded for that. He was ready enough to produce as much heat as could be required by the most fastidious appetite, but he acted in the spirit of the sensible and temperate man who desires to get as much as possible of the satisfactions of life out of a small income. His teaching was strictly adapted to the thriftiness and industry which spreads in many countries an air of comfort in the homes of persons of very modest means, which thriftiness and industry, if circumstances should become favorable for their extensive development in this country, would entirely transform the aspect and character of the greater proportion of our working population. A few figures with the accompanying explanation will render the outlines of Count Rumford's system perfectly clear. Fig. 1 gives a general view of the cooking arrangements provided in the house of a gentleman in Munich. Projecting from the wall is shown a mass of brickwork with a large semi-circular opening in the middle, the whole of the brickwork measuring eleven feet long, three feet wide, and seven feet four inches from front to back. Upon the horizontal surface of the brickwork are seen various cooking utensils, some with their covers on, others without, but each fitted into an aperture so as to leave nothing but the covers and handles projecting above. Below each cooking utensil a small fire-place was arranged, consisting of a grate to contain the fuel, an ash pit below, a door in the brickwork, in front of the ash pit, for the purpose of affording facility for removing the ashes and for regulating the supply of air to the fire; and, to the larger utensils,

another door, termed a stopper, was provided, through which fuel could be introduced to the fire-place. To the smaller utensils this convenience for supplying fuel was not provided, and the operation was performed from above on temporarily removing the utensil for that purpose. In every fire-place there was a small flue, which compelled the smoke and heat to pass round every portion of the utensil before their escape, and their exit was further checked by a damper in the escape flue, which was regulated so as to allow no heat to pass away as long as it could be safely retained. The utensil became in fact immersed in a sort of hot air bath; and to complete the arrangement, each cover was made double, with a hollow space between the two parts filled with air, which, acting as a non-conductor, most materially checked the escape of heat. By another device, an extra cover of wood, was carefully constructed and attached to the metal one. A small tube passing vertically through the middle of the cover afforded means, when necessary, for the escape of steam. A cooking utensil with its double cover is shown in the figures 2 and 3. The flues from the different utensils passed horizontally into four main vertical flues formed in the brickwork at back, by which the smoke escaped finally into the chimney.

Above the brickwork, and in the centre of it, against the wall, was a hearth on which a fire could be made when required. For roasting, two roasting ovens were built in the wall to the right of the projecting brickwork. Both ovens were heated by one fire, which of course was never kept alight more than was absolutely necessary. For hot water a boiler was provided within the body of brickwork itself, on the left side behind, as shown in the figures 1, 7, and 8. This was heated by the smoke and hot air which escaped from the three fire-places nearest to it, or

from whichever of the three happened to be in use; and whenever it was required to raise the water to the boiling point the burning of a few chips of wood or a small quantity of coal in a fire-place arranged below the boiler was found to suffice for that purpose. Fig. 6 shows a vertical section of one of the fire-places containing a large vessel, and Figs. 4 and 5 show the fire pot and grate, Fig. 7 shows a horizontal section of the brickwork containing thirteen small fire-places with the branch flue from each, the boiler on the left, and the four vertical flues; and Fig. 8 gives a perspective view from above, with a section of the vertical flues.

It requires a careful consideration of this most original system to see clearly what is the nature and exact extent of its intrinsic merits. The aspect of a number of cooking utensils, each with its distinct fire-place, and a separate convenience for roasting, is certainly a curious one, but a little consideration will suffice to show that the system was very different in actual practice to what it may appear at first sight. Under ordinary circumstances, one, two or three fire-places only would be used, whether for boiling water, for stewing, for preparing soup, or for cooking by steam, and these fire-places would of course be those situated on the left side, the heat escaping from which along the flues would be used to heat the water in the boiler behind. If but little cooking were wanted, but one small fire only would be lighted. This would be used first for boiling water, and subsequently for cooking. When the demands became greater, another fire could be lighted, and so on, the three fire-places communicating with the boiler being in all probability as much as was generally required for family use. If a large quantity of hot water was wanted this was obtained by supplementing the waste heat from the cooking utensils by a small fire

made temporarily below the boiler, and when roasting had to be performed, the necessary fire was of course made for that particular purpose. When the requirements were above the average further fire-places were set at work, and, on rare occasions, the whole might be in operation. Now, it will be at once evident that a remarkable amount of economy must have been effected by each fire-place being most carefully arranged to economise heat, and by the number of fire-places set at work being exactly proportioned to the work required at any time to be done. Instead of a waggon and a pair of horses, to which our insular system of cooking may be likened, always at work carrying now an article of trifling weight, occasionally something more, very often carrying nothing, here were a number of ready servants, one, two, three or more of which could be had at a few minutes' notice, and, except when absolutely wanted, consuming nothing at all.

For the purpose of ascertaining the comparative cost of cooking with an open and with a closed fire, Count Rumford made certain experiments. He found that a large boiler containing twenty-eight gallons of water required sixty-two and a half lbs. of wood to boil the water and to keep it boiling for two hours when an open fire was used. With a closed fire-place it required only thirteen and a half lbs. He experimented with a copper saucepan used in an open fire-place, and again in such an enclosed fire-place as is shown in Fig. 1. In the one case he consumed eleven and a half lbs. of wood, and in the other one and three-quarter lbs. He discovered that at least seven-eighths of the heat commonly produced were lost, and that speaking generally five times as much heat was required with an open fire-place as it was when the fire-place was closed, and on taking the various sources of economy into consideration, he ultimately came to the

conclusion that no less than nine-tenths of the fuel commonly consumed could be saved. And truly, compared with Count Rumford's careful and artistic system, our present common methods appear very much like throwing a pail of water to fill a tea-cup.

In the various public establishments where Count Rumford's system became adopted, there were certain modifications relating particularly to the boiling of water, and the preparation of soup in large quantities, particulars of which are given in his essays. In Figs. 9, 10 and 11 is shown an outline of his arrangements at the House of Correction, and Military Academy at Munich. Figs. 12 and 13 give sketches of other useful cooking utensils introduced by Count Rumford, and Figs. 14 to 18 are given to explain his system of roasting meat in ovens which did not succeed at that time in overcoming prejudice in England, but which now possesses particular interest from its having become generally understood, and adopted some fifty years after his death. The Count's antagonism to the open range was heightened when he contemplated the smoke-jack, which he considered upon economical grounds, to be a most preposterous contrivance. He thought an open fire was wasteful and objectionable enough in any case, but the idea of a fire being made of extra power for the express purpose of sending much heated air up the chimney, so that the current might turn the wheel of the jack, that the wheel might turn the loaded spit in front of the fire, appeared to him the climax of absurdity, especially when he reflected that a piece of machinery, on the principle of the clock, constructed to be wound up occasionally, as in the bottle-jack at present in use, would effect all that was required. It was a chance circumstance at Munich, which revealed to him the possibility of meat being cooked in an oven without the disagreeable flavor,

which from the want of a simple precaution, had been found to be peculiar in meat so prepared, and this led him to make a special study of the question with results as useful as those which followed any of his investigations. His experiments satisfied him that the peculiar taint of baked meat, was due simply to the fact, of melted fat from the meat being allowed to fall on a very hot surface, becoming burnt and infecting the enclosed air. This evil he avoided by the construction of a water-dish, which, as subsequently made, consisted of a tin dish in two parts, as Figs. 14 and 15, one part fitting on the other, so as to leave a space between the two. Into the hollow space, water was introduced, which slowly evaporated, and kept the heat of the metal below that of boiling water. A metal grating placed above the dish supported the joint, and as long as water was in the dish it was found that the meat was as totally free from taint, as when cooked before an open fire. Count Rumford was not the man to do things by halves. Without having any tendency to indulge in epicurean habits, his sense of taste was keen. He concluded from his observations, that the open fire used for roasting afforded too fierce a process, and that a slower system would less exhaust the meat of its juices, and be both more perfect and more economical. He therefore arranged his roasting ovens for a slower process, and introduced certain details which gave them additional value. To the top of the roaster he attached a metal tube, which could be opened more or less, at pleasure, and which was led into the chimney for the purpose of allowing steam from the oven to pass away whenever necessary. Below the roaster he arranged two tubes, termed "blow pipes," which opened into the room with movable covers attached, and entered the roaster behind, as shown in the figures 17 and 18.

The mode Count Rumford adopted of using the roaster, was as follows. It was first prepared for use by means of a gentle fire. The water-dish was inserted with the metal grate and joint upon it, and during the operation of cooking, the oven door was opened three or four times for the purpose of basting or turning the joint, and the damper in the steam tube was opened just sufficient to let the steam escape. A quarter of an hour before the joint was ready for the table, the blow-pipes were opened, and the steam-tube was opened as wide as possible. A brisk fire was then made by adding a few pieces of wood. The blow-pipes became exceedingly hot, and a rush of very hot air into the roaster, rapidly browned the surface of the joint, and made it in appearance, all that could possibly be desired. Count Rumford found that by this process, a joint of meat weighed more when cooked, that it tasted of better quality, and that the rejected portions were much less in quantity than when prepared under the more exhaustive process of the open fire.

Figs. 17 and 18, shows the roaster as it was fixed with the face of it level with the wall, and with certain arrangements for economising the heat. The fire-place is shown at some little distance below the bottom of the roaster, the object of the precaution being to prevent the iron-work from becoming quickly destroyed. The heat from the fire passed round each side of the roaster to the top and down the back, by means of a flue, to some distance below the bottom and then into the chimney, the object of the descending current being both to heat the back of the roaster and to check the escape of the hot air. The door was either made double, or with a wooden face to it for the purpose of confining the heat. For large establishments, two, three, or four roasting ovens were provided, all of which were heated by a single fire.

Count Rumford's scientific system, not only throws much into the shade our own methods, whether old-fashioned or modern, but it also compares most favorably with the systems adopted in other countries where economy in fuel is attended to more strictly than it is with us. In America, and on the continent of Europe generally, our lavish system of using a powerful fire, and wasting large quantities of heat is avoided, but Count Rumford's careful provisions for preventing loss of heat by radiation are not followed. There is in fact no probability of economy in the use of fuel for cooking purposes, having been carried out so completely since his time.

CHAPTER II.

On the present Common Methods of applying heat for Cooking purposes, with various Suggestions for improvement, and a description of certain arrangements which are calculated to obtain a high degree of Economy, and appear to be adapted for general introduction in this Country.

However useful any new contrivance or arrangement may be, it will inevitably fall into disuse, and be forgotten if it be strongly opposed to the habits and prejudices of the class of persons for whose use it is intended, or if it be so adapted as to make any greater claim upon their intelligence than they are accustomed to. Count Rumford's fire-places were small, and from being closed, they required but little attention, but no fire was to be seen, flues had to be occasionally cleaned, and, worst of all, the system was altogether different to what anyone in England had ever seen before, and therefore, could not answer. In fact, the idea of cooking a good dinner without a large open fire, was regarded as simply preposterous, and it is not surprising, therefore, that Count Rumford made no lasting impression in his endeavors to introduce close kitchen fire-places. And if it should prove that we have hardly yet arrived at the period when so radical an alteration could be effected with success, it must be remembered that our servant-maids show only the same deficiencies as many of their superiors in station, who

resist tramways, and resisted railways, and every other innovation upon the prevailing practices of the time as long as the new systems had not become generally understood and appreciated. It may be most useful in this chapter, not to attempt any elaborate arguments in favor of the closed fire, but to examine the present methods in use, and to indicate what is the nature of the improvements that could probably be effected without violently disturbing existing usage.

Fig. 19 represents the most common sort of open kitchen range used in the Home Counties of England, in which the large fire is used to roast and boil, a boiler placed at the back and on one side of the fire, is used to supply hot water, a winding cheek is used to expand or contract the fire-place as desired, and an oven is provided for baking. The mode of heating this oven is peculiar. A thick lump of iron is cast upon one side of it, as shown in Fig. 20. The fire lies against this lump, and against the side of the oven, and the flame of the fire in playing over the side of the oven and around the lump heats those parts considerably, and the whole of the oven becomes fairly but rather unequally heated on the principle of conduction.

Fig. 21 represents a kitchen range of a much better kind, in which a current of hot air from the fire is allowed to pass round the oven to the bottom, to spread below the oven, and thence escape to the chimney by a flue arranged behind, as shown in Fig. 22.

Fig. 23 represents an arrangement for a large family, of which it may be said, that it is eminently in accordance with some old-fashioned English notions of plentifulness and cheerfulness. There is the large open range with smoke-jack and spit; a boiler with a flue underneath it, heated by a current of hot air from the immense fire; a separate

arrangement of ovens, the fire for which, being close, may easily be economical; a hot-plate heated by a closed fire, and some small separate fire-places for burning charcoal. What a different world this would be, if the plentifulness of which such a sketch is significative pervaded every country upon it!

These open ranges have long been giving way in favor of the "kitchener" principle, which may be supposed to unite the advantages of the open range and hot-plate, and which is particularly valuable from its reproducing some of the suggestions strongly urged by Count Rumford. Fig. 24 represents a kitchener of the most simple construction. The top forms a hot-plate, an oven is on one side, and a boiler on the other. The fire-place above the kitchener is fitted round with glazed tiles, and an iron frame fixed across, called a plate-rack, adds to the general convenience. Higher up, the chimney is closed, but it is provided with a door, which is opened on certain occasions. The mode of heating the oven is the same as in Fig. 22, viz. by a current of air from the fire passing round it and up the back, as shown in the section, Fig. 25. Count Rumford's roasting-dish, Fig. 14, is used. A provision is made to let vapor escape from the oven by an opening in the top of the oven, which is regulated by a small handle, and fresh air is allowed to enter the oven through a tube below it, or through two or three small slits near the bottom of the oven door. The boiler is sometimes heated in the same way as the oven, viz. by a current of hot air from the fire passing round it and up the back, in which case the whole of the top metal surface of the kitchener forms a "hot-plate" for cooking. In other cases, the boiler is heated differently. It is made to inclose the fire behind and on one side, as shown in Fig. 26. The flue is dispensed with, and the top of the boiler

appears to be an actual part of the hot-plate. There is a great advantage in this system, for the only current of air from the fire is that used for heating the oven, and not only is the boiler sufficiently heated by mere contact with the fire on two sides, but it is readily capable of supplying steam if necessary for cooking, no further provision being required than a properly-constructed tin steam-kettle, which is simply placed over the boiler, on the boiler cover being removed. The arrangement is a more economical one than that of heating the boiler by a flue; but there is a certain loss of hot-plate surface, a matter of no moment in many small families.

Fig. 27 represents a kitchener on a larger scale with an oven on each side, both heated by currents of hot air passing round them as already described, and a boiler behind the fire heated by a third current of hot air, passing from the fire directly underneath the boiler, and up the back of it into the chimney. The arrangement of flues for the ovens and boiler with the means for checking the escape of the hot air, are shown in the figures 28 to 32. The boiler in this case when constructed of the shape shown in the section Fig. 32, is competent to provide steam for cooking. Two or three steam-kettles are fixed in some contiguous position, and a pipe passing from the top of the boiler supplies the steam to them as desired, admission being given by means of a metal tap. Very frequently a hot cupboard, constructed of tin or iron, is also heated by steam, and is put below the kettles as shown to the left in Fig. 23. The cupboard is made double. The steam passes between the inner and outer case, and along the hollow part of the shelf, and, as it condenses, it escapes by a pipe provided from the bottom of the cupboard, into a neighbouring drain; or a tap is sometimes provided below the cupboard for the purpose of letting the

water run off occasionally. A waste steam-pipe provided with a safety-valve is made to pass from the top of the boiler into the chimney, that the steam may escape as soon as it has attained anything beyond a very low pressure.

Most frequently cooking by steam is avoided, and the boiler is then perhaps, devoted to another purpose, generally considered of greater importance, viz. the providing a large quantity of hot water for use in a warm bath, and for general household purposes. As comparatively few persons beyond those whose business it is to understand such matters know what the simple process is by which large quantites of hot water are provided at a considerable distance from a fire, a short description of it may not be without its use. In the first place the boiler, which may be anywhere, but for convenience' sake is often the one attached to the kitchen apparatus, is made perfectly close, the cover being firmly cemented and fastened, and never removed except for the purpose of cleaning the boiler. There are two round holes made in the boiler, one in the top, the other at or near to the bottom, and to these holes pipes are attached, which ascend in some convenient way to the ceiling of the chamber, and thence to a cistern, made generally of sufficient capacity to hold from seventy to two hundred gallons of water, and which is fixed in some convenient position in the floor above, or on an upper story. The pipe which passes from the top of the boiler, is called the ascending circulating pipe; the pipe which returns from the cistern to the bottom of the boiler is called the descending circulating pipe, and the cistern is called the hot-water circulating cistern. The cistern, pipes, and boiler, are kept supplied with water from a cold water cistern which is necessarily provided on a somewhat higher level and a small regulating cistern furnished with a ball tap and fixed contiguous to the hot--water cistern,

is used to regulate the supply, and to make it perpetual as long as water can be obtained from the cold-water cistern.

As soon as a fire is lighted, the whole being properly charged with water, circulation begins. The water in the boiler rises as it becomes heated and ascends the upper pipe, cooler water from the lower pipe taking its place. As the heating process continues, the hot water ascends to the circulating cistern, and a rapid circulation of water ensues from the boiler to the cistern and back by the descending pipe to the boiler until the water, both in the pipes and cistern, attains a high temperature. In the boiler and ascending pipe the water is of course hottest. In the return pipe it is coolest. The hot water is drawn off either by a branch from the boiler, or by branches from the hot-water cistern, or from one of the circulating pipes. One branch may pass to a warm bath; other branches may supply hot water at various points, such as to wash-hand basins, to a shower-bath, to a scullery, &c. In some cases the principle of circulation is extended, so that the current of hot water may have to find its way through a series, or a coil of pipes, for the purpose of giving heat to a hall or a conservatory before it finds its way back to the boiler. Some provision is necessarily made, so that the circulation may be thus extended or not at pleasure. All these arrangements, shown in Fig. 33, do not, of course, particularly concern the kitchener. The principles of hot water circulation, whether for heating buildings or for providing hot water in large quantities, are applied in much the same manner; and they concern the kitchener only with respect to the facility which it offers for such additional conveniences to be applied. The same conveniences can be used with the open range, though not to the same extent, inasmuch as a much more sluggish cir-

culation is obtained by the use of an open fire; and they can, of course, be used in connection with a boiler wherever it is placed, though then a fire must be made expressly, whereas the kitchener may always enable a warm bath to be had at a few minutes' notice. It cannot be denied that such an arrangement gives a look of admirable completeness, and that the boiler appears generally to be better devoted to this purpose than in providing steam for cooking. Some have indeed sought to make the kitchener answer both purposes by using two boilers; but this leads to complication, and increases the possibility of an excessive consumption. The only practicable means of making one boiler answer the double purpose of supplying steam for cooking and heating water for a bath is to use the boiler for steam purposes only, and to connect the boiler by means of a pipe with a hot water cistern, which pipe should enter the cistern, and be wound round within it in the form of a coil stopped at the end to prevent any communication with the water in the cistern. Care should be taken that no condensed steam lodge in the coil, but that it should drip back into the boiler. This method of heating the water by steam, instead of by circulation, is rather adapted for the use of a small family than for anything on an extensive scale.

Whether or not the kitchener be used with any of these additions, it must fairly be admitted that it is a very clean and complete contrivance. It has succeeded in making a good impression; and, most important of all, it satisfies the servant maids, who appear to have become attached to it as they have become familiar with its working. But it has drawbacks which are inherent to it as at present constructed, and which will not probably be found to require the exercise of any considerable amount of science to be effectually overcome. In the first place, it gives out a

great deal of heat; and this difficulty cannot be avoided while the presence is permitted of a large surface of highly-heated metal. In the second place, from the chimney being closed above, a mixture of scents arising from cooking operations pervades the apartment, and these scents may frequently be carried up stairs by a current of air to the inconvenience of the inmates, or may even find their way through the ceiling and floor boards into the room above. In the third place, more expense is incurred for repairs in the kitchener than with the old kind of range; and this is due to the fact that the constant use of a semi-closed fire, by which a powerful heat is engendered, is liable to wear out with comparative rapidity the parts which come in contact with the fire. And, lastly, an objection may justly be made with respect to economy; for, whatever may be the conveniences of the kitchener, it can hardly be supposed that a contrivance which throws off so powerful a heat can be strictly economical, and, what is equally true, but to a casual observer is not equally apparent, is that the amount of hot air which is carried off by the flues, often in a great measure from careless management, is such as to put out of the question any idea of there being strict economy. The fire may be much smaller than in the open range; but this does not prevent it burning with greater rapidity.

Heat of the Kitchener.

With respect to the first difficulty, certain palliatives to the heat of the kitchener may be found, first, in using a metal screen before the fire, as shown in Fig. 36, which, when turned up so as to hide the fire, greatly lessens the heat radiated in front of it; and, secondly, by using Count Rumford's double doors to the ovens, which, by

confining the heat within, greatly prevents its injurious escape; but the most important assistance may be gained by avoiding metal as much as possible, and substituting for it tiles. This would involve a considerable modification of the kitchener—a matter that will be considered further on.

Ventilation of the Kitchen.

The second difficulty mentioned relates to the ventilation of the kitchen. It has been already explained that a door is provided above the kitchener which opens into the chimney. If this door were always open, much of both cooking smell and heat would escape; but it is found that to open the door so interferes with the draught of the flues, that the cooking operations become impeded, and the door must perforce be closed at the very time ventilation is most required. Sometimes an Arnott ventilator is put into the chimney below the ceiling, which allows air from the room to escape freely; but even then it is often necessary to allow the ventilator to be only a little open, so as to diminish the current of air escaping. What the author conceives to be a most excellent arrangement is one described by him in his work on Ventilation, which consists of a funnel of the shape shown in Fig. 35, which is fixed over the fire-place, with the flat tube carried to above the height where the small flues enter the chimney. The effect of this arrangement is, that a constant ascent of air from the kitchen is permitted which the tube precludes from interfering with the proper action of the flues.

There are cases, however, where this remedy would not suffice to remove all inconvenience, and a modification of certain constructional arrangements in the dwelling could alone effect it. What is to be done, for instance, in a

house where the general supply of air by outer doors and by windows is totally insufficient to replace that which passes away by the chimneys when fires are in use? As the house becomes in some degree exhausted of air, it is absolutely impossible to prevent the ascent of the less rarefied air from the kitchen department by every possible medium of access, and a powerful draught when the door or doors of communication are opened. The air thus ascending necessarily furnishes evidence of what is going on below; and any attempt to remedy the inconvenience in the kitchen itself is about as likely to be entirely successful as are the efforts of a person who is looking industriously for an article he has no wish to find. The only clear and sensible remedy for such a state of things is to avoid a rarefied atmosphere above. Sufficient air must be allowed to enter a house to replace what escapes, or the inevitable consequence is that the atmosphere feels oppressive as compared with the external air; that there are down currents in chimneys; that there are smoky chimneys, and, of course, draughts of air from other portions of the dwelling which are more freely provided. Many persons, when they feel a draught of air at a door or window, invariably try to improve matters by putting baize round the door, or by having the casement more carefully fitted, not reflecting that they can only succeed thereby in making matters worse than before; for, as long as an open fire is in use, air must be had, and if it cannot came in by the usual means it will descend the chimney. To attempt to exclude air under such circumstances appears like smothering up a man who is gasping for breath. It is not in the slightest degree difficult to prevent draughts. Indeed, a house might have a fire burning in every room, and yet there be no perceptible draught. To find a remedy we must turn away from the

doors and windows where the air enters, and pay close attention to the channels of exit *where the air escapes.* Proper regulators should be provided to the chimneys, which should be opened just sufficient to let the smoke escape and no more. A change of this kind checks cold draughts instantly, and the room becomes more easily and more perfectly warmed; and if, in addition, a supply of air be allowed to enter the room from the outside by means of a channel arranged to open in proximity to the fire-place, a window may be opened in the coldest weather and there be no draught, and it need hardly be said that the air of the kitchen department will manifest no perceptible inclination to offend the nostrils of the occupants above.

The Wear of the Kitchener.

The third objection mentioned relates to the comparative rapidity with which the parts in contact with the fire become destroyed. This is not an evil of serious moment, but a necessity for which every one should be prepared, to a certain extent. In a semi-closed fire-place the heat is much more intense than in an open one, and is therefore more destructive to the iron or brick which encloses it. The economy may readily be, and should be, such as to render any necessary expense for repairs a matter of no serious inconvenience. Indeed, the matter can only be of serious importance in kitcheners on rather a large scale when they are used recklessly. In all cases the parts should be as indestructible as possible, and be readily replaced.

The Economy of the Kitchener.

Upon this question—the most important of all—much may be said. The kitchener, excellent as it is as a rudi-

mentary composition, is susceptible of so much improvement with respect to economy, considered of course in connection with perfect efficiency, that if one of its features after another were carefully examined and considered, and if everything possible were done by way of amelioration, it would inevitably end in being transformed into an article that could hardly be said to bear any resemblance to its original. Waste of heat may now be readily traced to four causes.

Firstly. To the too free admission of air to the fire, which promotes rapid combustion, but greatly reduces the temperature of the air which passes round the flues.

Secondly. To the exposure of a large surface of hot metal which, instead of confining and economising the heat, radiates it to waste.

Thirdly. To the rapid draught which is permitted by the flues to the chimney, which carries off the warm air instead of its being properly retained and utilised.

Fourthly. To the use of a single fire for all purposes, small or great. It is not possible to adapt a single fire so that its consumption shall be in exact proportion to the amount of work required to be done at any hour. A certain amount of waste must inevitably occur even when the most careful provisions are made to insure economy; and, practically, this waste is considerably augmented, owing to the neglect of servants.

The various means which can be adopted for effecting economy may be considered under the heads of

1. The Fire-place.
2. The Ovens.
3. The Boiler.
4. The Dampers.
5. The Hot-plate.
6. Other means.

On the Fire-place of the Kitchener.

The most important part of the kitchener, with respect to economy, is the fire-place. It is usually made of a cubical form, measuring some ten or twelve inches each way, with a metal grating at bottom, movable covers at top, and a door in front, to cover some three or four inches of the fire below the top surface. This door is closed whenever heat is required for the ovens or the hot-plate. On other occasions it should be left open, so as to avoid any unnecessary consumption of coal.

The first point readily susceptible of improvement relates to the depth of the fire. It is not necessary that it should be so deep as ten or twelve inches. The only advantage of a deep fire is, that it enables a joint to be roasted in front, but this is an advantage of scarcely any practical value. For it to be available, the door must be left open, and then the ovens and hot-plate are imperfectly heated. Besides, the roasting of joints is now invariably done in the ovens, so that the only real use of the front fire is for toasting bread, and for certain other small purposes of cooking, for which a less depth would be found amply sufficient. The hot-plate and the ovens receive their heat entirely from the upper portion of the burning fuel. The boiler may be most perfectly heated by the shallower fire, and if, therefore, the depth were made some six or eight inches instead of ten or twelve, the advantages would be, that there would be less heat given to the inconvenience of the persons present, and less waste of coal. Some years ago, the writer's firm encountered the evil of the deep fire by making the bottom grate to be wound up and down, so that the fire might be used deep or shallow at pleasure. This arrangement shown in Fig. 27, is very much better than to use a fire that is

always a deep one, but it could not be so economical as a fixed shallow fire always burning close to the hot-plate.

A further suggestion is that the bottom on which the fire rests, should be of fire-brick, pierced with a number of holes for the dust to fall through, and not of iron. The fire-brick may be flat as shown in Fig. 34, or of an elliptical form. Just as in the case of the fire-grates, the fire-brick proves most effectual in retaining the heat, in promoting a more perfect combustion of the coal, and in checking by its limited apertures, the unnecessary entrance of air from below, and the descent of coal or combustible matter from the fire.

A third suggestion is to use the fire on the slow-combustion principle, by closing the fire in front, allowing a small supply of air to enter the fire through some holes in the door, and checking the entrance of air through the brick or iron grate by means of a regulator which could be arranged at the ash-pit as shown in Fig. 38. It was a saying of Count Rumford, that any air which entered a kitchen fire, and which was not required for combustion, was a thief which stole the heat, and escaped with it up the chimney, and his remark aptly indicates the scrupulous care which should be used in availing ourselves as largely as possible of so important a means of economising fuel. The difficulty is that the open fire becomes dispensed with as long as it is used on a slow-combustion principle, but, with a door made to open and fire-bars behind, this is a matter of no moment, as the fire could then be used either open or closed as desired, and the alternative would act most beneficially, by enabling servants to become gradually accustomed to the use of a closed fire.

A fourth suggestion which experience has repeatedly proved to be of the highest value, is to adopt the smoke-

consuming principle by furnishing a receptacle to contain coal for the day's supply, making a fire on the top and raising the fuel from below to be gradually consumed, on exactly the same principle as by the Cutler's and Arnott's grates, with which the public have of late years been familiar. The moderately and steadily burning fire of great heating power, which is never cooled by a quantity of fresh fuel being thrown on the top to smother it for a time, and which, compared with the ordinary means of using coal, is not productive of smoke and soot, affords peculiar means of adding to strict economy and convenience. This fire may of course be open or closed at pleasure. The brick bottom becomes superfluous. Many years since an endeavor was made by the author's firm to introduce this plan, but it fell through in consequence of its meeting with the opposition of servants, who disliked what was new to them, and which they did not generally care to understand. Nevertheless, the advantages of the system were fully recognised by all who took any interest in the matter, and though the principle has been left for some years in abeyance, it is one that should unquestionably be revived. There is no difficulty whatever in the very simple machinery being brought to such a degree of perfection, that any shadow of an objection would be removed, and, as our servant-maids have succeeded in becoming accustomed to the use of the kitchener within a few years, it would surely be unreasonable to despair of their adapting themselves to a new method of supplying the fuel. See Figs. 36 and 37.

The Ovens.

For the purpose of presenting the greatest amount of convenience in the smallest space, the ovens of the

kitchener have invariably been put below the hot-plate, and a current of air from the fire passing between the oven and hot-plate, has been designed to heat both, as shown by the sections Figs. 25 and 28. This current of air is made then to descend against the outer side of the oven, and to pass underneath it, there to spread and to escape by a flue arranged behind the oven into the chimney. Waste of fuel and an absence of efficiency result from this arrangement. The descent of air for the purpose of heating the oven causes the fire to cling, as it were, to the top of the oven in its passage from the fire, and to heat the hot-plate insufficiently, unless a fire is made of considerable power. The oven, too, is found to be hotter at top than at the bottom. An attempt has been made to rectify the inconvenience by a more complicated system of flues, a description of which would probably be considered too technical for this essay, but a preferable method, wherever it can be adopted, is for the ovens to be situated above the hot-plate, and one on each side of it, as shown in Figs. 38 and 41. The current of hot air from the fire passes then under the hot-plate, under the oven, up each side of the oven, over the top of it, and it should also be advantageously made to descend behind it before escaping into the chimney, for the purpose of heating the back of the oven, and checking the rapid escape of the hot air, as in the system adopted by Count Rumford for heating his roaster, shown in Fig. 17. When the size of a fire-place does not present sufficient width for the hot-plate and for the oven or ovens placed above it, the old system must necessarily be adopted.

The oven might further be improved by the adoption of Count Rumford's admirable system of using a double door with an empty space between the two parts, the inner and outer plate being separated when fastened together by

some non-conducting and incombustible material. A treble effect is gained by such a system. The oven is more regularly heated, fuel is economised, and less heat is given where its presence may occasion discomfort. But it is possible to improve on Count Rumford's system, by availing ourselves of the facilities we now possess of lining the outer surface of the doors with white tiles, which are admirable non-conductors, and always look clean and cheerful.

The Boiler.

There could hardly be a more economical system of heating the boiler than the one shown in Fig. 26, where no current of air is diverted for the purpose, but the contact of the boiler with the fire at back and on one side, suffices not only to heat the water, but to produce steam for cooking. This system is only adapted, however, for cooking on a comparatively small scale. When the demands are greater two ovens are required, and the whole of the top surface is required for use as a hot-plate. The boiler is then placed behind the fire, and is generally of the shape shown in Fig. 32. It is heated partly by contact with the fire, and partly by a current of hot air, which is allowed to pass from the fire under the boiler and up the back of it into the chimney. The flue constructed under the boiler gives the most direct escape for air from the fire. Its draught is, therefore, very powerful, and it becomes absolutely necessary that it should be checked by means of the damper shown in the figure, both for the purpose of preventing the wasteful escape of the heat and unnecessary combustion of the fuel, and to enable a great portion of the hot air to find its way round the other flues for the purpose of heating the ovens and hot-plate. Careless servants are in the habit of neglecting this most essential

point, so that they actually allow the heat to escape to waste by the boiler flue at the very time it ought to be diverted for the purpose of heating other portions of the apparatus. The reason why power has been given them so to misuse the kitchener, is that a rapid draught into the chimney is required at the time of lighting the fire, that the whole concern may be put into working order as rapidly as possible. This is obtained by opening the damper of the boiler flue. After this object is gained, the damper should be nearly closed, and upon no account left open more than is necessary to keep the water up to a certain temperature. It may be opened for a few minutes when necessary to make water boil, and should then be closed again, or nearly so. There is no point so apt to be neglected, and which so much requires attention, as the damper to the boiler flue when arranged in the manner described. If the various improvements already indicated with respect to the fire-place were carried out, there would not be such a liability as at present to waste of fuel and heat from the recklessness of servants, for however neglectful they might be, the draught could not become anything like as powerful as it frequently is at present; but the only thoroughly effectual remedy is to remove from the servants the possibility of obtaining a very rapid draught by allowing no direct communication with the chimney, and making the hot air take a more circuitous passage for heating the boiler, as indicated in the description to Fig. 40.

The Dampers.

No damper should be open more than is strictly necessary to allow the smoke and gases from the fire to escape. If desired to heat an oven quickly, the damper belonging to it may be opened for a short time, but it

should be made to check the escape of the heat at the earliest moment.

The Hot-plate.

This most distinctive portion of the kitchener is highly valued in consequence of the facility which it affords for cooking at a greater or less rate of speed over the whole of its surface. It is heated as already explained, by currents of hot air from the fire, which pass directly beneath it. But though the hot-plate offers a very superior method of cooking to the old crude system of the open range, a little consideration will suffice to show that it is susceptible of considerable improvement, or rather, it should perhaps be said, that it is susceptible of a modification which would render it, in all probability, as superior to what is now used as that is superior to the open fire. The disadvantage of the hot-plate is, that it is always heated to a greater or less degree, whether required for use or not, and that a considerable surface of heated metal is consequently diffusing heat during the entire day, while only a portion of that entire surface, and that during certain portions of the day, is actually turned to account. This consideration suffices at once to show what a large scope there is for economy, for if the various cooking operations could be conducted without a hot-metal surface, always sending a great portion of its heat to cause inconvenience and waste, the gain would be very great. Thanks to the excellence of Count Rumford's teaching, there is no occasion to travel far to find a remedy. Figs. 38 to 40, represent a sytem of heating various cooking vessels, by which as little heat as possible is given into the kitchen, and the heat of the fire is used with strict economy. Instead of a large heated surface over which vessels can be placed indiscriminately, a surface is shown of glazed tiles or glazed

bricks, with a certain number of metal rings and covers arranged in two rows. The heat of the fire is supposed to pass in separate currents under the whole of these covers, instead of under the whole surface of a metal plate as at present, and it only becomes necessary to have cooking utensils to fit the various apertures, or apertures to fit the cooking utensils, for a portion of Count Rumford's most valuable teaching to be at once adapted for modern use. By removing a metal cover, a utensil can be immersed at once in the hot air, and if a double cover for the vessel itself be used, such as Count Rumford recommended, and if proper arrangements be made for compelling the hot air to pass under the bottom of the vessel and around the body of it, as indicated in the section Fig. 40, it will be heated by a careful and economical method, and allow exceedingly little heat to be given into the kitchen, instead of by the present crude system of simply standing the vessel on a hot iron plate, which, besides communicating the heat indirectly, allows both hot-plate surface and cooking utensil to radiate heat constantly to waste. If only a little heat should be wanted, the vessel would be placed upon a hot metal cover instead of being immersed in the hot air, and if it be considered that the number of covers represent as many vessels as could be used at one time, it appears inevitable that the substitution of such a system for the hot-plate, would simply be largely represented by coal in the cellar instead of coal in the fire. By the adoption of such a system, with the other modifications already suggested, the general use of a fire of smaller dimensions would of course become indispensable.

On other Means of improving the Kitchener.

It now remains to be considered whether or not there is any further suggestion that could be made for rendering the kitchener a more economical and generally acceptable article of daily use. The suggestions already considered relating to the ventilation, the improvement of the fire-place, by making it less deep, by using a brick bottom and a closed door, by using a slow-combustion principle, or by adopting the principle of preventing smoke on the well-known plan of lighting a fire at the top of a body of coal, and raising fresh fuel from below; the improved method of heating the hot-plate and oven, by raising the oven, so that the bottom of it may be about on a level with the hot-plate; the use of double doors to the ovens, or of doors lined with white glazed tiles for confining the heat, and, lastly, the substitution for the hot-plate of a system by which the various cooking utensils, protected by double covers, could be actually immersed in the hot currents of air which pass from the fire—these suggestions appear to be unquestionably calculated to transform the kitchener, in a great measure, from a dashing and improvident servant into one that bears some evidence of possessing a regard for economy and care; and if another suggestion may deserve equal prominence, it is, that as much as possible of the heated metal surface should be discarded, and be substituted by glazed bricks, or by brickwork covered with glazed tiles. In Figs. 34 to 41, the various suggestions which have been made are supposed to be combined. Figs. 38 and 41 show two fire-places, the first on a small, the second on a much larger scale, in both of which heated metal is rejected as much as possible, and a tile surface substituted. The fire may be open or not at pleasure; economy is strictly provided for

in the modes of heating the ovens, boiler, and hot-plate; and if such a system may appeal successfully to the understanding, either of the reader who considers the subject for the first time, or of those whose occupation makes them familiar with the details of existing practice, it can hardly appear doubtful that the particular ameliorations here described ought gradually to become adopted, and the present imperfect methods fall into utter disuse.

A further direction in which economy may be effected is by the partial adoption of Count Rumford's system of using several fire-places, each small, and constructed to be used very economically. Any such system as that shown in Fig. 1 requires an advocate possessing a peculiar amount of enthusiasm; but if servants would not tolerate it, it may nevertheless be perfectly practicable to apply the principle within lesser limits. In Fig. 42, for instance, is shown a system by which the two ovens on the left may be prepared for roasting or baking, by means of a small fire made specially beneath the lower one, the other fire-place being used for constant purposes. This allows of the regular fire-place being smaller, and therefore of consuming constantly less coal than when it must be of sufficient capacity for heating the ovens as well as the hot-plate and boiler. The boiler in this case is imbedded behind the tiles on the right, and is supposed to be heated by the surplus heat which escapes from the fire along the flues of the hot plate. In Fig. 43 is another adaptation of the principle, where the fire in the centre is used primarily to heat the hot-plate, and to give heat to the hot closets below it, and in which sufficient surplus heat is provided to warm the ovens on the left, and to heat the water in the boiler sufficient for common purposes, which may be to 150 degrees. If the ovens were actually required for baking or roasting, and if the water

in the capacious boiler were required to be boiling hot, small fires made underneath the ovens and the boiler would most rapidly give all that was required, and, when the requirement ceased, the fires would of course be allowed to cease also. Particular regard deserves to be paid to this system, for there can be no doubt that the use of one principal and of two supplementary fires affords great scope for economy over anything that can be effected when a single fire is used capable of acting for all purposes.

In the preceding suggestions as much has probably been advanced in the way of improvement as need satisfy the most exacting, and certainly as much as is likely to find extensive acceptance at the present period. That the suggestions are valuable, and would lead, if properly adopted, to nothing less than a reduction of our consumption to a third, or perhaps even a fourth of what it now is, is not only perfectly true, but the fact is one which should excite no surprise. Our present kitchen fire-places are so abominably wasteful—far worse to everyone's knowledge than our means of warming by open grates or by other contrivances—that it only requires for the various sources of waste to be clearly pointed out, together with the evident means of avoiding them, for the truth to be made clear. That even more could, under certain circumstances, be accomplished, and that Count Rumford actually did accomplish more, there can be no doubt; but in small things as in great, no real progress is made except by degrees, and whatever may be accomplished at the present time, it cannot but be that a further advance will one day be possible, when economy in fuel is more scrupulously considered, and when the homes where our domestic servants receive their early training are better fitted to develop their industry, truthfulness, and intelligent care.

American Cooking Stoves.

There are some contrivances chiefly imitated from foreign manufacture which increased intercourse with other nations has brought forward of late years, and which appear to deserve some words of comment. Fig. 44 represents an American cooking stove called the Excelsior, which was brought to the Exhibition of 1851 by Mr. Lyman D. Burch, an American manufacturer, and was subsequently sold in this country as a regular article of commerce. It was entirely closed, was of cast iron, and though it consisted of some thirty parts, was arranged to be put together in a remarkably ingenious fashion, the amount of labor required being most incredibly small. The stove had two ovens—a large and a small one—and the top formed a hot-plate, upon which water was boiled in a large tin vessel, various covers being made movable to provide every necessary facility. When the fire was lighted, the smoke was allowed to escape at once into the smoke-pipe provided for it; but as soon as the fire was well made, a damper closed the ready access to the chimney, and the heat was made by a most ingenious arrangement of flues to pass completely round the internal casings of both ovens before it could escape into the chimney. This, like so many other American contrivances, exhibited a freshness and a strength of inventive faculty that was really marvellous to those who could appreciate it. It was for some time imported; but at a later period various cooking stoves, copied from American manufacture, became produced in this country, and they are now used to a certain extent. With respect to economy, the American stoves are much better than the cooking contrivances we have been accustomed to, as they greatly economise the heat which we allow to escape by the chimney; but

they are equally faulty with ours in allowing a great deal of heat to be lost by radiation. In some parts of America and in Canada this is probably not regarded as a matter of any moment, because the coldness of the climate renders such a stove useful for the purpose of warmth; but it is a question whether it would not be invariably preferable to disregard the question of warmth, and to construct a cooking apparatus on the most economical system for cooking only, leaving the provision for warming to be given by other means when really required. Upon this point European practice is generally defective. Figs. 45 and 46 represent cooking stoves of Norwegian manufacture, which resemble the American in system so far as being closed, but they have not the same striking originality.

Gas Cooking Stoves.

A few years since many persons entertained the idea that the gas in use for lighting would become a substitute for coal in the preparation of food, but their expectation is very far from having been realized. There was something novel and striking in the idea of one being able to obtain a supply of heat instantaneously, merely by applying a match, and of discontinuing the heat as suddenly by turning a tap. Gas was used in ovens for cooking joints and baking, a row of gas jets being provided all round the bottom, with hooks or shelves to carry the joints, and dripping-pans below. Gas was also made to burn in a sheet of flame for broiling or toasting, and it might have succeeded in supplanting coal to an enormous extent if there had not been an insuperable difficulty, and that was the expense. Let those who are partially disposed say what they may, carburetted hydrogen gas used for heat, cannot for a moment compare in economy with

the solid fuel from which that gas is made. It is not a question of comparing coal used extravagantly and gas used economically. Both should be used with care if a proper comparison is to be made. But even with our extravagant method of using coal, gas has not held its ground, and this is due not merely to the expense incurred in producing the gas, but to the fact that the rejected part of the coal used in making the gas, is exactly that from which we obtain nearly all our heat, viz. the carbon which the gas companies leave in the form of coke. When the ingenuity of man can succeed in readily converting a whole body of coal into inflammable gas, we may entertain the hope of such gas competing successfully with the coal itself, but probably not otherwise. Gas is used to some extent for cooking in many large establishments, and in some hotels, dining-rooms and clubs. Chops and steaks are sometimes broiled over rows of gas jets instead of over a common fire, and, for family use, gas has sometimes been introduced to supersede the use of charcoal stoves by some such arrangement as is shown in Fig. 47. The author has alluded to this and other matters from a desire to make his information as complete as possible, and he only trusts that some substantial good may result from his attempt to awaken interest in this much neglected department of domestic economy.

Figures 1 to 6.

Fig. 1. Sketch showing the arrangements for cooking provided by Count Rumford in a private establishment at Munich.

a, *a*, *a*, body of brickwork, within which are thirteen small fire-places for preparing food when required in thirteen cooking utensils fitting upon the top surface.

b, *b*, *b*, *&c.* the thirteen cooking utensils, some with covers, some without.

c, boiler which receives the surplus heat from the three fire-places nearest to it.

d, *d*, *d*, *d*, "Stoppers" which cover the apertures by which fuel is introduced to four fire-places.

e, *e*, *e*, *&c.* doors by which air is admitted to the fire-places and the ashes are removed.

f, *f*, *f*, fire-place with hearth below. A fire was made on the hearth to warm the apartment when necessary.

g, *g*, soot doors communicating with two of the flues by which the smoke passes away from certain of the fire-places.

h, *h*, roasting ovens.

Fig. 2. One of Count Rumford's cooking utensils, with its double cover.

Fig. 3. Section of the double cover.

a, small tube for the escape of steam.

Fig. 4. Count Rumford's bottom grate used for burning wood.

Fig. 5. The fire-pot.

Fig. 6. Vertical section, showing

a, portion of the brickwork.

b, utensil for cooking or boiling.

c, bottom grate.

d. ash-pit.

Fig 1.

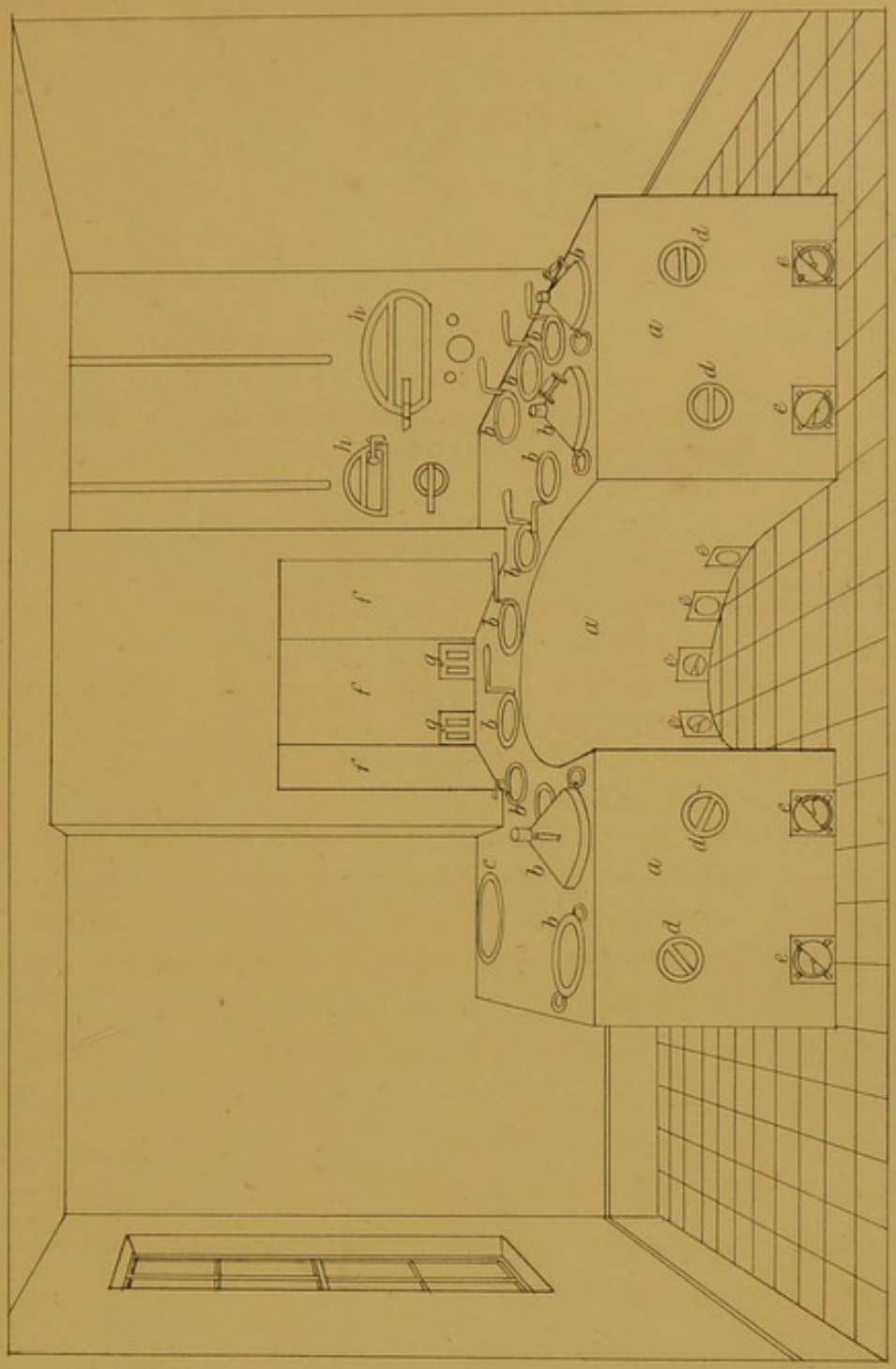


Fig 2.

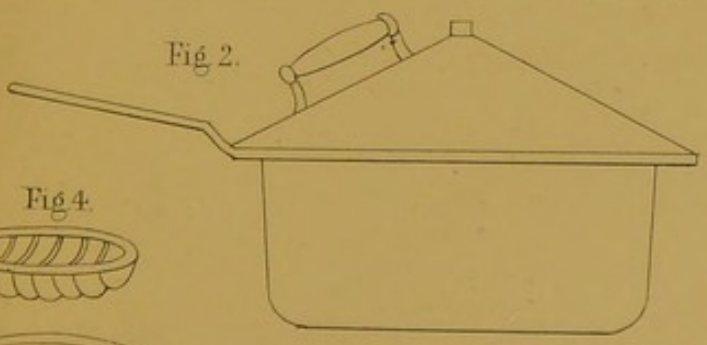


Fig 4.

Fig 5.

Fig 3.

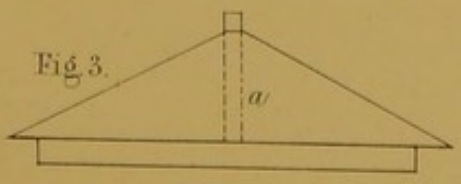
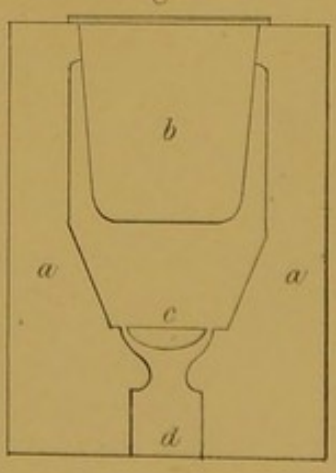


Fig 6.



Figures 7 to 9.

Fig. 7. Horizontal section, showing the arrangement of the thirteen fire-places of Fig. 1, and their various flues.

a, *a*, *a*, Three fire-places communicating by the flues *b*, *b*, *b*, with the opening *c*, in which the boiler is inserted, and then with the flue *d*, by which the smoke escapes into the vertical flue *e*, which enters the chimney.

f, *f*, two fire-places communicating by the flues shown with the vertical flue *g*.

h, *h*, two fire-places communicating by the flues, shown with the vertical flue *i*.

k, *k*, *k*, *k*, *k*, five fire-places communicating by their respective flues with the vertical flue *l*.

e, *g*, *i*, *l*, vertical flues all communicating with a main chimney.

m, *m*, *m*, *m*, stoppers by which fuel is introduced to four fire-places.

Fig. 8. Sketch of the top surface of the brickwork showing the thirteen cooking utensils, the boiler *c*, and the four vertical flues, *e*, *g*, *i*, *l*.

n, *n*, *n*, *n*, soot doors to afford facility for cleaning the flues.

Fig. 9. Sketch showing the cooking arrangements provided by Count Rumford for the House of Correction at Munich.

a. *a*, *a*, top surface of a similar projecting body of brickwork to that shown in Figures 1 and 8.

b, *b*, *b*, *&c.*, utensils for cooking and boiling.

c, *c*, two large vessels for cooking in large quantities.

d, position of boiler heated by the surplus heat from the fire-place attached to the large vessels *c*, *c*.

e, fire-place for roaster.

f, *f*, *f*, *f*, main flues for the fire-places.

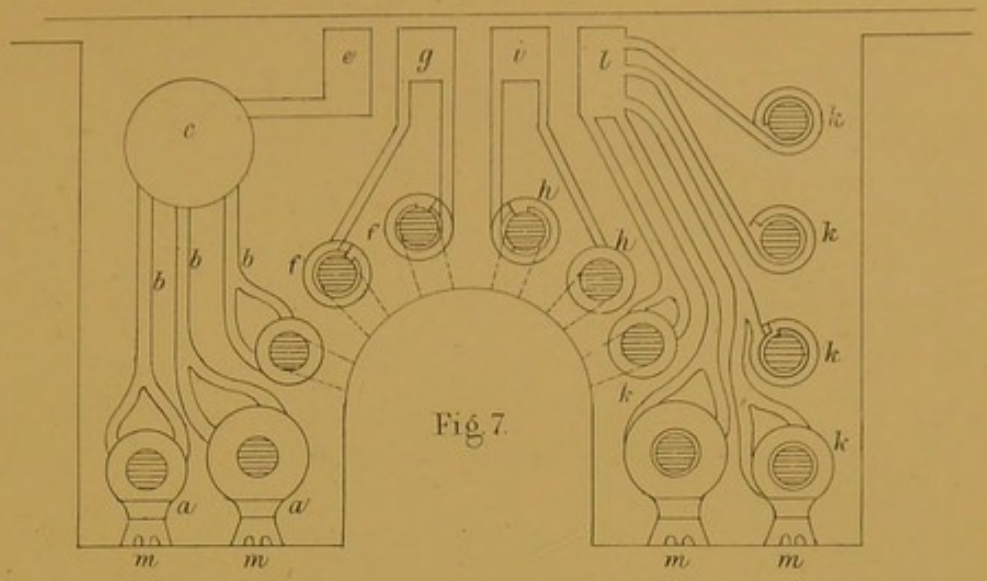


Fig 7.

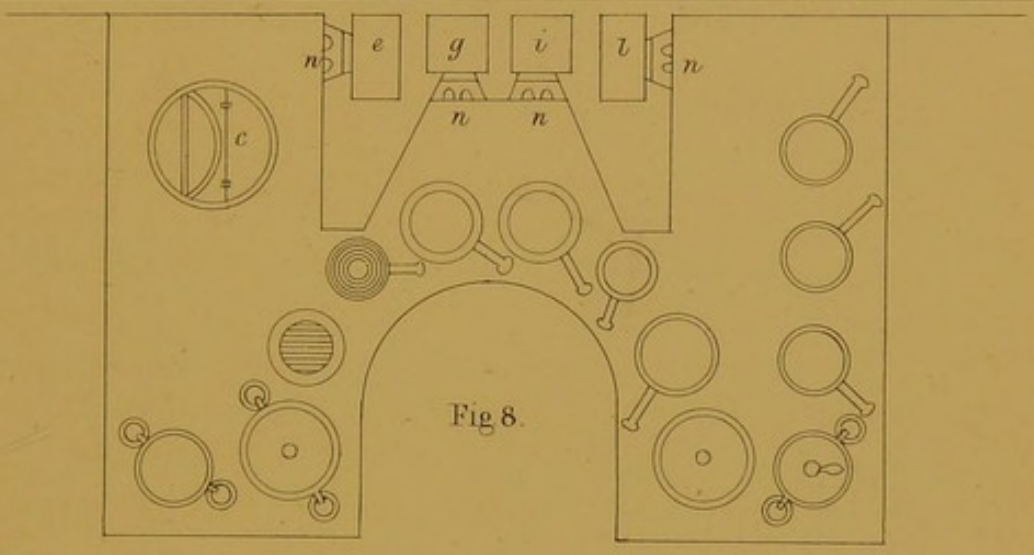


Fig 8.

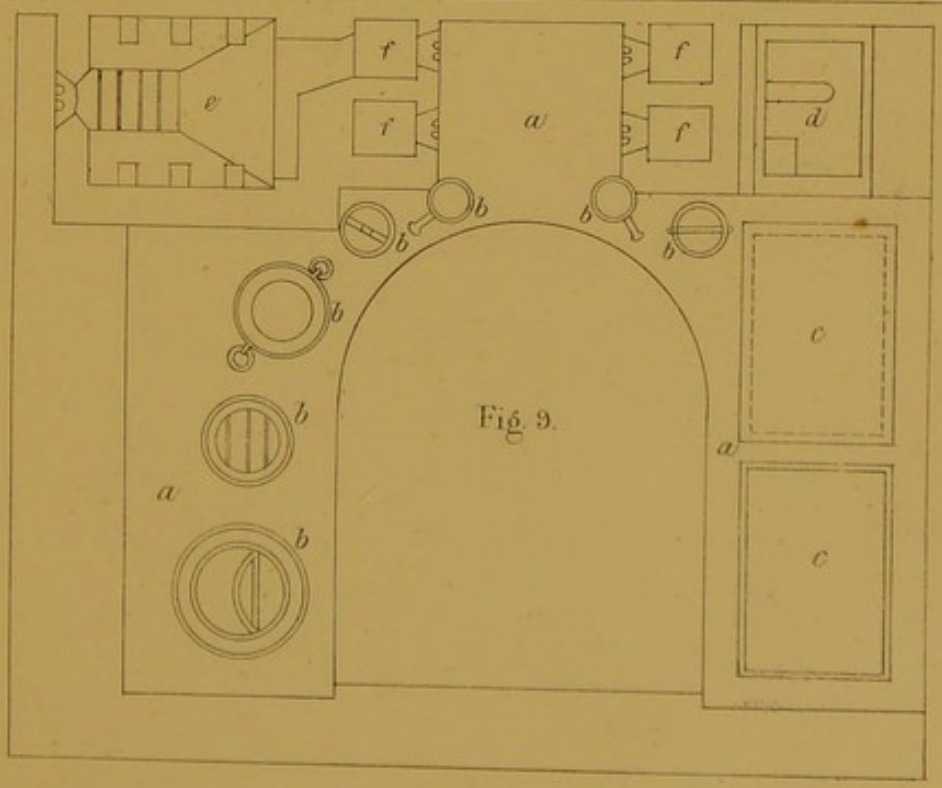


Fig. 9.

Figures 10 to 13.

Fig. 10. Sketch showing the cooking arrangements provided by Count Rumford at the new kitchen of the Military Hospital, at Munich.

a, *a*, *a*, top surface of a projecting body of brickwork to answer the same purpose as that shown in Fig. 1, but fixed against two sides of a room. The brickwork extended along thirteen feet seven inches of one wall, and eleven and a half feet of the other.

b, *b*, *b*, *&c.*, utensils for cooking, boiling, &c.

c, position of roaster.

d, position of boiler heated by the surplus heat from the various fire-places.

e, *e*, *e*, main flues here shown in section. *f*, corner with hearth below, where an open fire could be made.

Fig. 11. Horizontal section of Fig. 10, showing the various fire-places and branch flues.

Fig. 12. Count Rumford's boiler, with steamer above for cooking.

a, position of fire-place.

Fig. 13. A similar arrangement, but on a larger scale, the whole enclosed by brickwork.

a, boiler.

b, steamer.

c, *c*, *&c.*, brickwork.

d, external cover of wood.

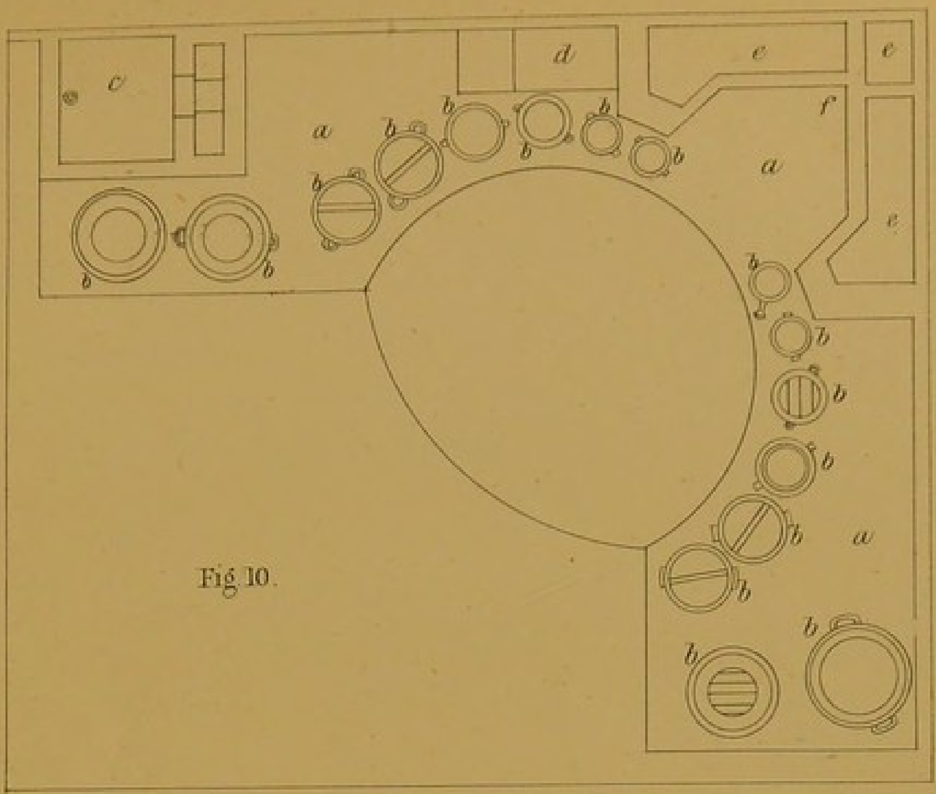


Fig 10.

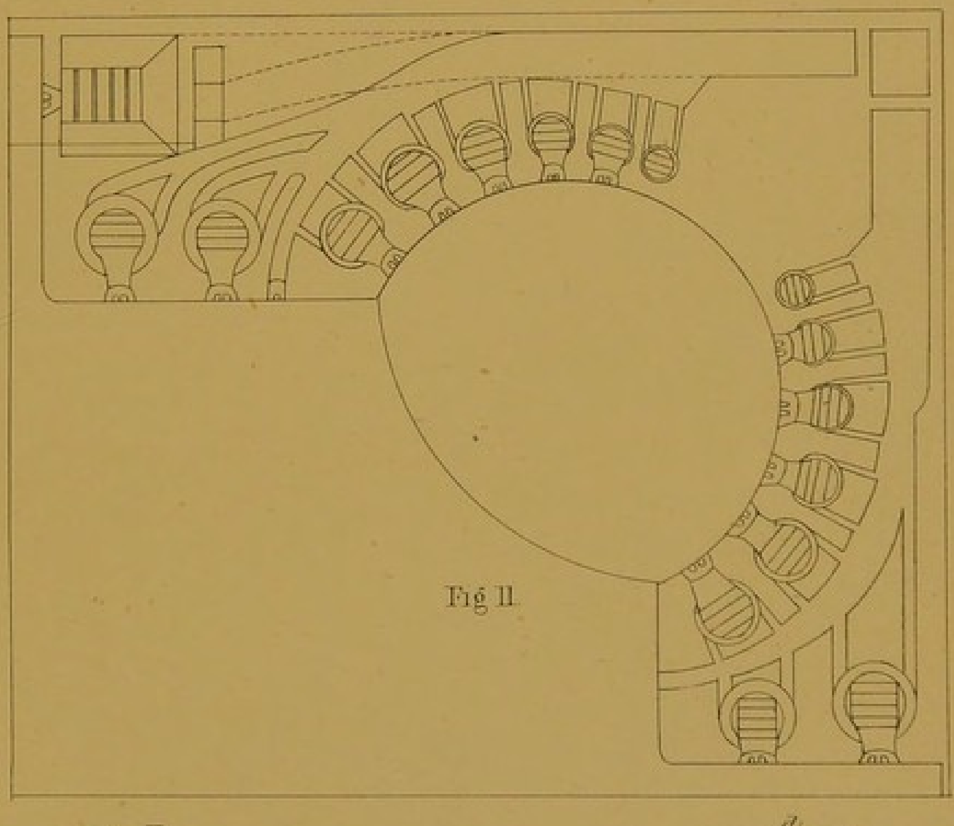


Fig 11.

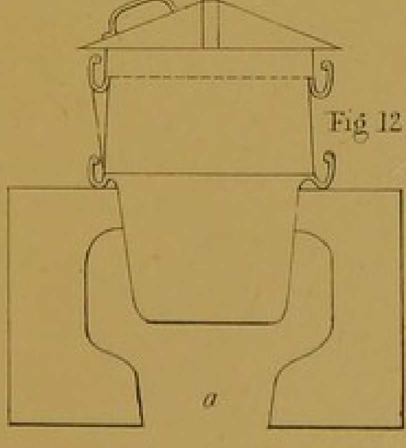


Fig 12

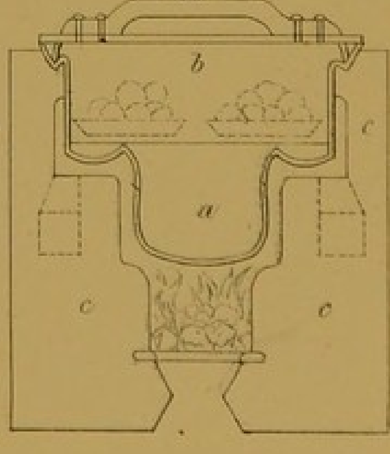


Fig 13

Figures 14 to 18.

Fig. 14. Count Rumford's double roasting-dish, with iron grating to support the joint.

a, aperture by which water is introduced.

Fig. 15. Section of double roasting-dish.

a, hollow space containing water.

Fig. 16. Sketch of Count Rumford's roasting-oven.

a, double door to prevent waste of heat.

b, roasting-dish.

c, *c*, blow-pipes for giving currents of hot air to the oven.

d, pipe for the escape of vapor.

Fig. 17. Transverse vertical section, showing the roasting-oven fixed in its place.

b, roasting-dish.

c, blow-pipe.

d, pipe for the escape of vapor.

e, door for introducing fuel.

f, door for regulating supply of air and removing ashes.

Fig. 18. Sketch of roaster fixed in brickwork.

a, double door.

c, *c*, blow-pipes.

e, fire door.

f, ash door.

g, soot door for cleaning flue.

Fig. 14.

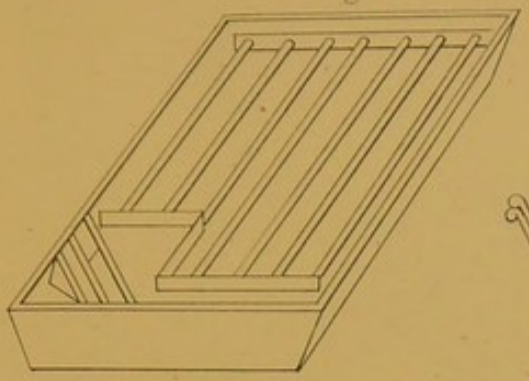


Fig. 15.

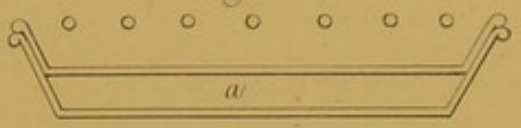


Fig. 16.

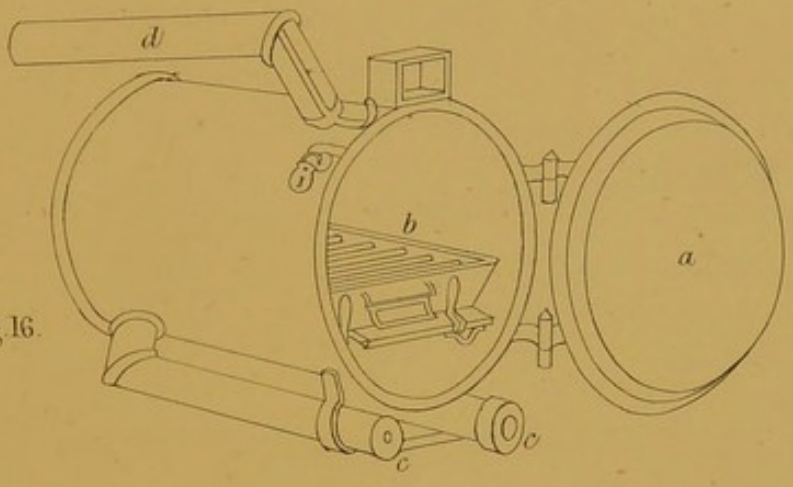


Fig. 17.

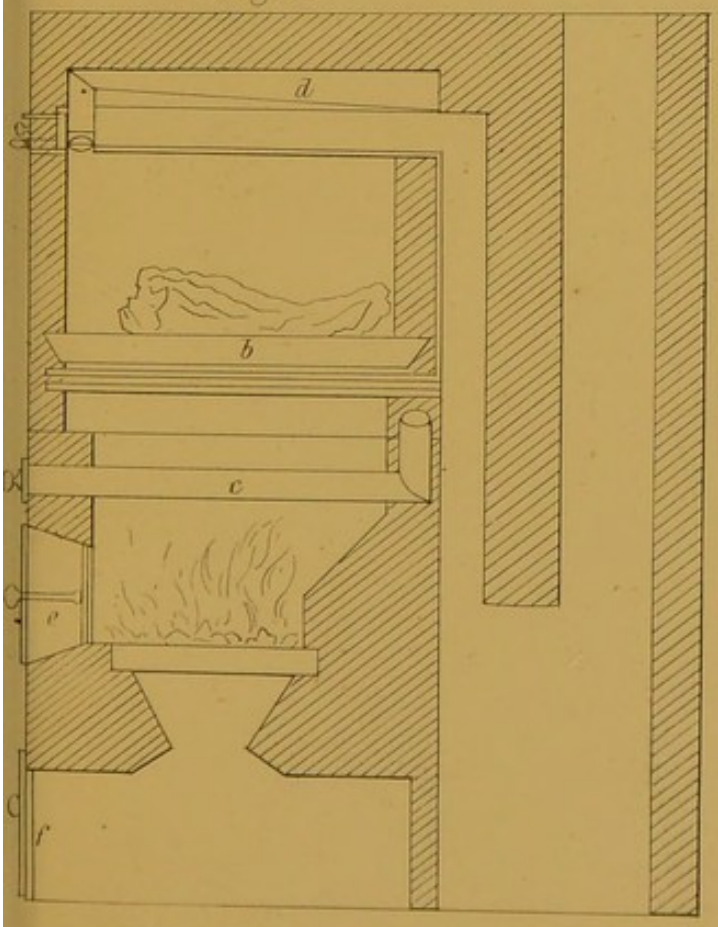
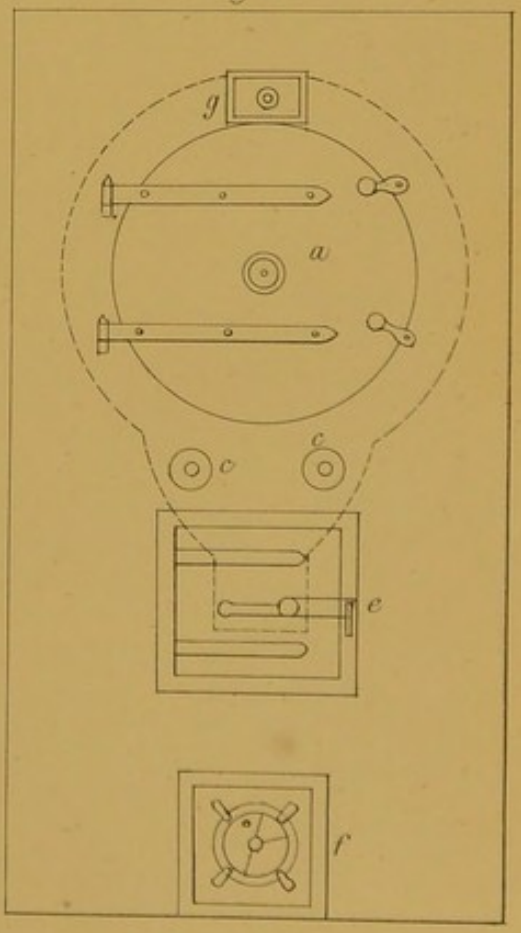


Fig. 18.



Figures 19 to 23.

Fig. 19. An ordinary open fire kitchen range.

a, conductor for heating oven.

b, boiler.

Fig. 20. Sketch of oven showing the conductor *a*.

Fig. 21. Sketch of a kitchen range in which the oven is heated by a current of hot air from the fire.

d, *d*, *d*, doors for cleaning flues.

Fig. 22. Section of oven showing the flue provided round it for the hot air, and the vertical flue *a*, behind, by which a passage is provided to the chimney.

b, soot door for cleansing flue.

c, damper to check the escape of the hot air.

Fig. 23, Sketch showing the ordinary cooking arrangements of a large private establishment.

a, large open fire kitchen range with wrought boiler behind.

b, large jack, with fly-wheel in chimney for setting it in motion.

c, hot-plate with a hot closet for warming plates, &c.

d, large oven for baking, heated by a separate fire.

e, warm closet heated by steam from the kitchen boiler.

f, *f*, *f*, steam-kettles supplied with steam for cooking by a pipe from the kitchen boiler.

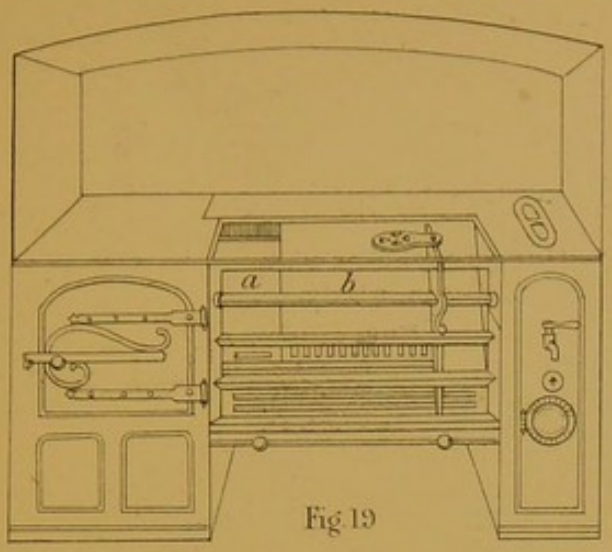
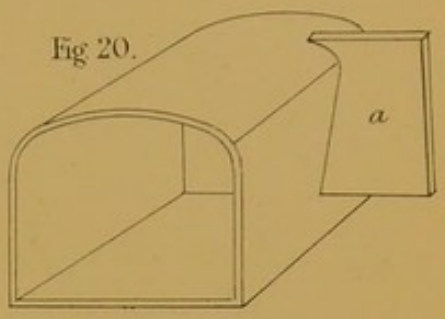


Fig. 19

Fig. 20.



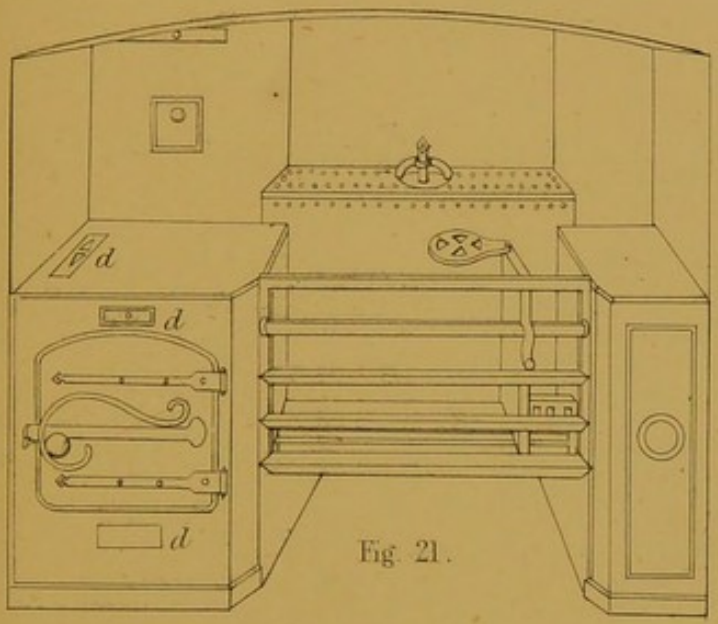


Fig. 21.

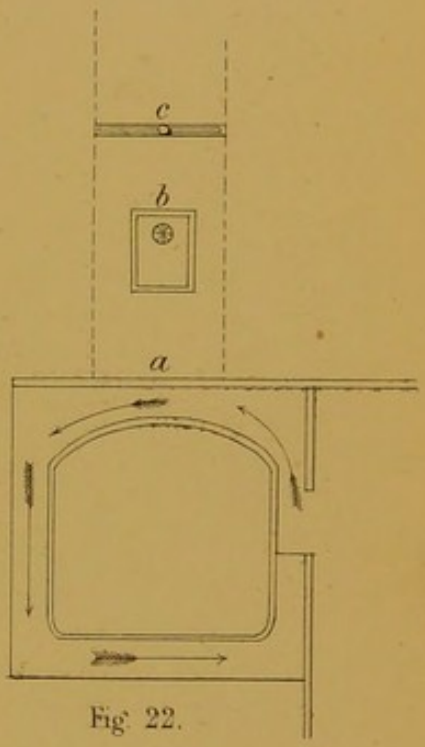


Fig. 22.

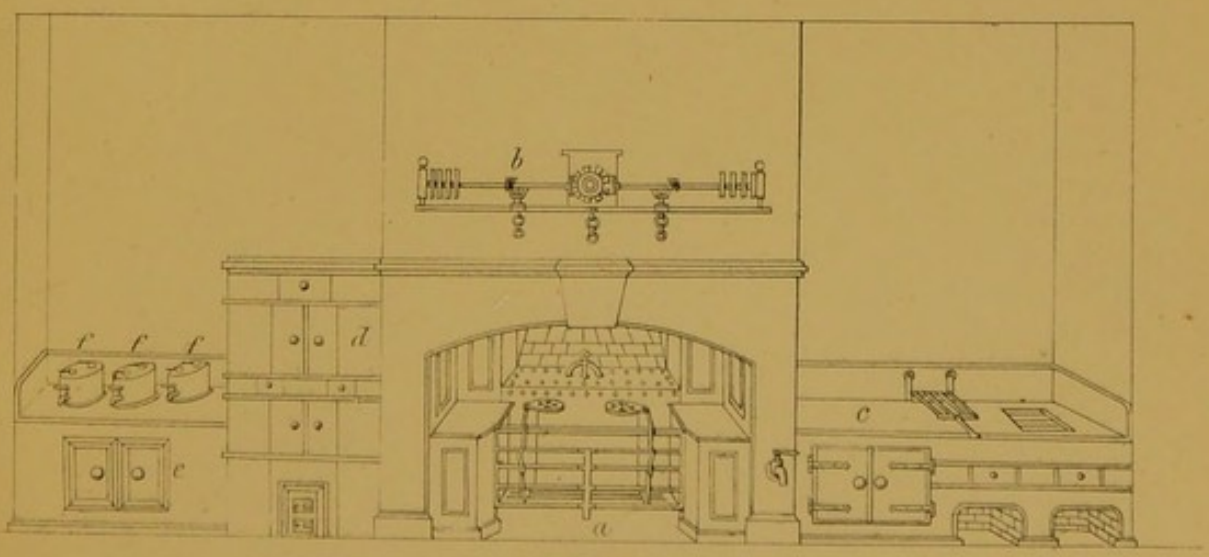


Fig. 23

Figures 24 to 26.

Fig. 24. Sketch of a kitchener with an oven on one side, a boiler on the other, a hot-plate above for cooking, an iron rack for warming plates, and white tiles to line the back and sides above the hot-plate.

a, handle by which steam from the oven can be allowed to escape when desired.

Fig. 25. Longitudinal vertical section, showing the oven and boiler in its place, with the passage provided for a current of hot air to heat the oven.

a, *a*, vertical flue behind the oven and the tiles, indicated by dotted lines, for the passage of the air from under the oven.

b, soot door to afford facility for cleansing flue.

c, damper to check escape of hot air.

Fig. 26. Horizontal section showing the shape and position of the boiler, the flue provided over the oven for the current of hot air, and the vertical flue behind the oven.

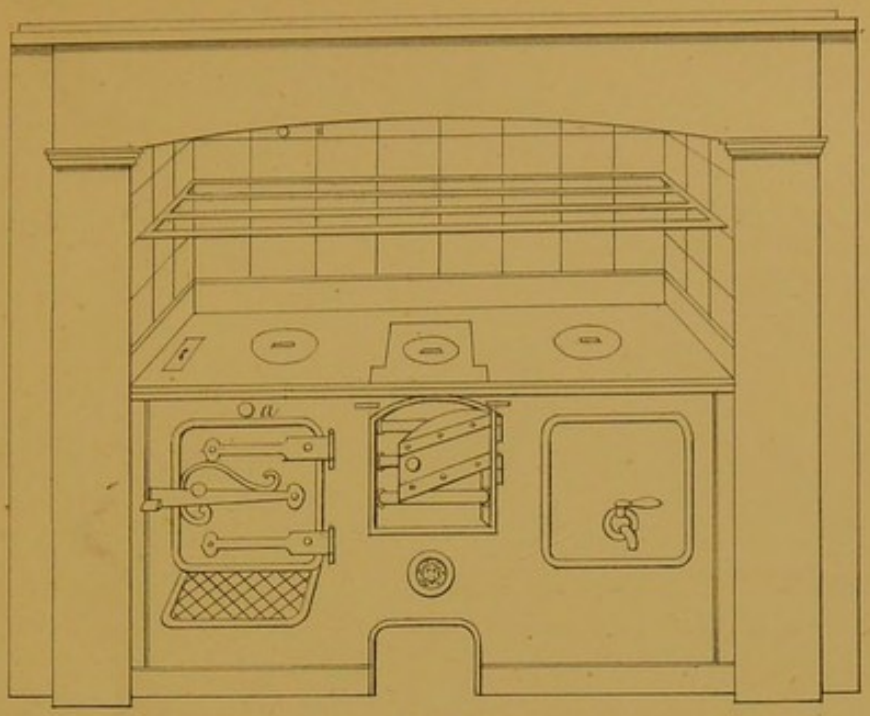


Fig 24.

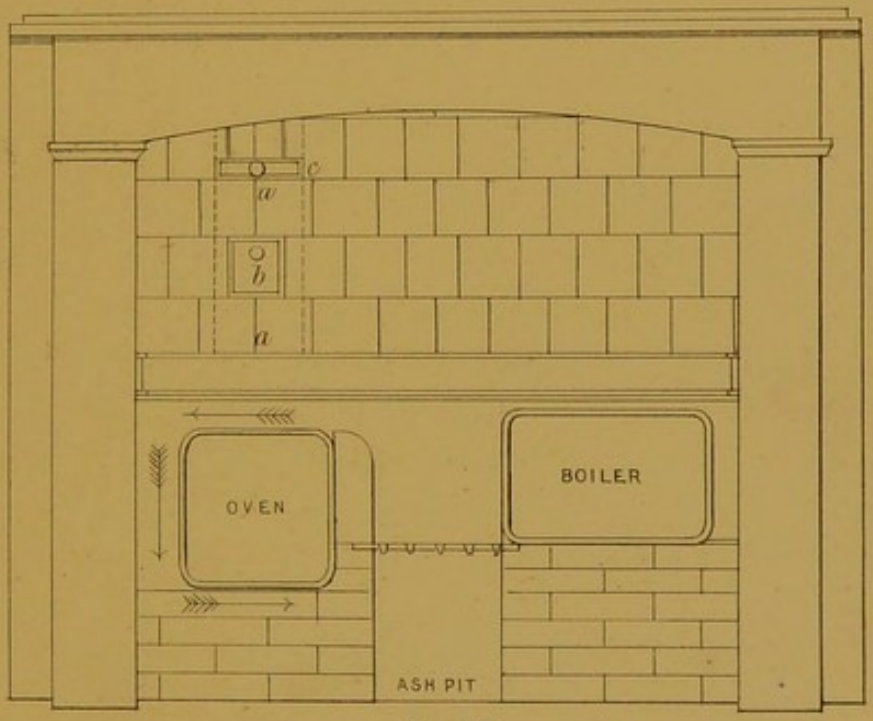


Fig 25

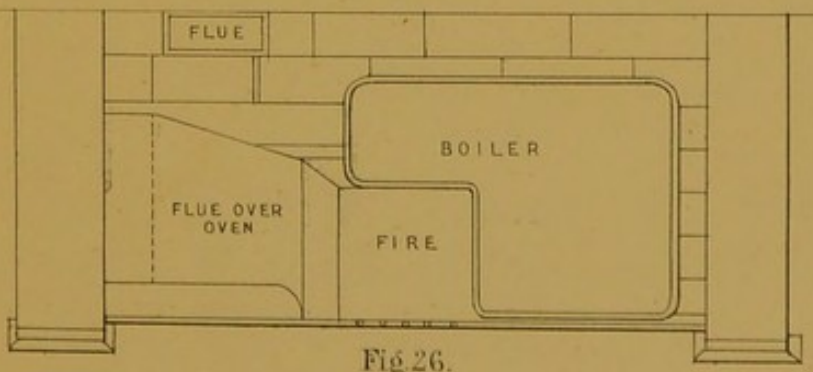


Fig 26.

Figures 27 to 29.

Fig. 27. Sketch of a kitchener provided with two ovens for roasting or baking, a wrought iron boiler behind, a hot-plate surface for cooking, an iron frame for warming plates, and tiles to line the back and sides above the hot-plate.

a, *a*, handles which are pulled out when it is desired to let steam escape from the ovens.

b, a winder by which the bottom grate can be wound up or down, and the fire be made deep or shallow at pleasure.

c, *c*, *c*, *c*, soot doors.

d, *d*, dampers.

Fig. 28. Longitudinal vertical section, showing position of ovens and boiler, with the flues for the passage of hot air.

c, *c*, soot doors opening into the flues behind the ovens.

d, *d*, dampers to oven flues which should never be more open than necessary for heating the ovens.

e, damper to boiler flue, which should never be open more than necessary for heating the boiler.

Fig 29. Horizontal section, showing the flues provided over the ovens for the passage of hot air, and the vertical flues behind the ovens and boiler.

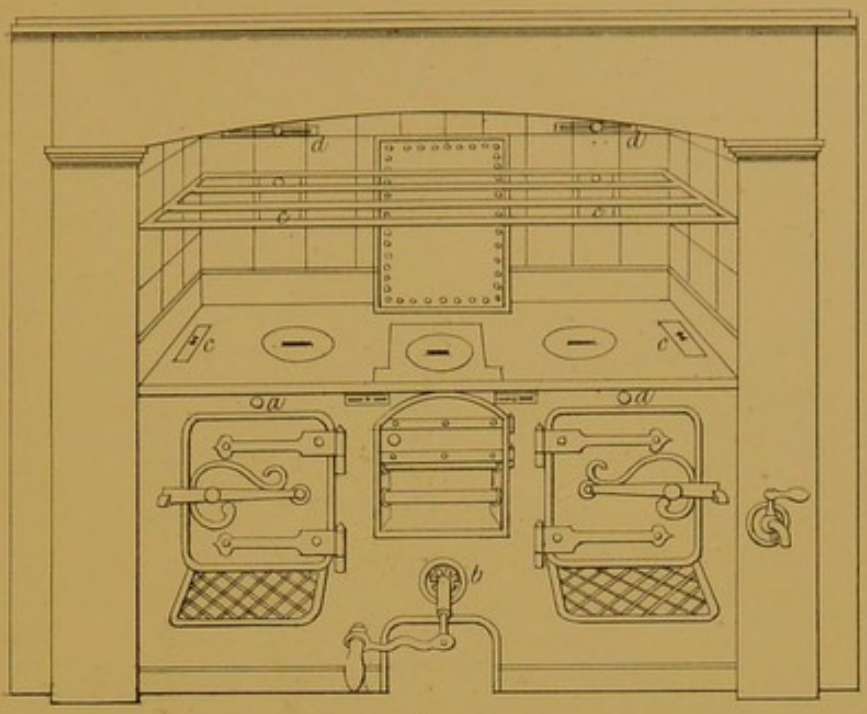


Fig 27

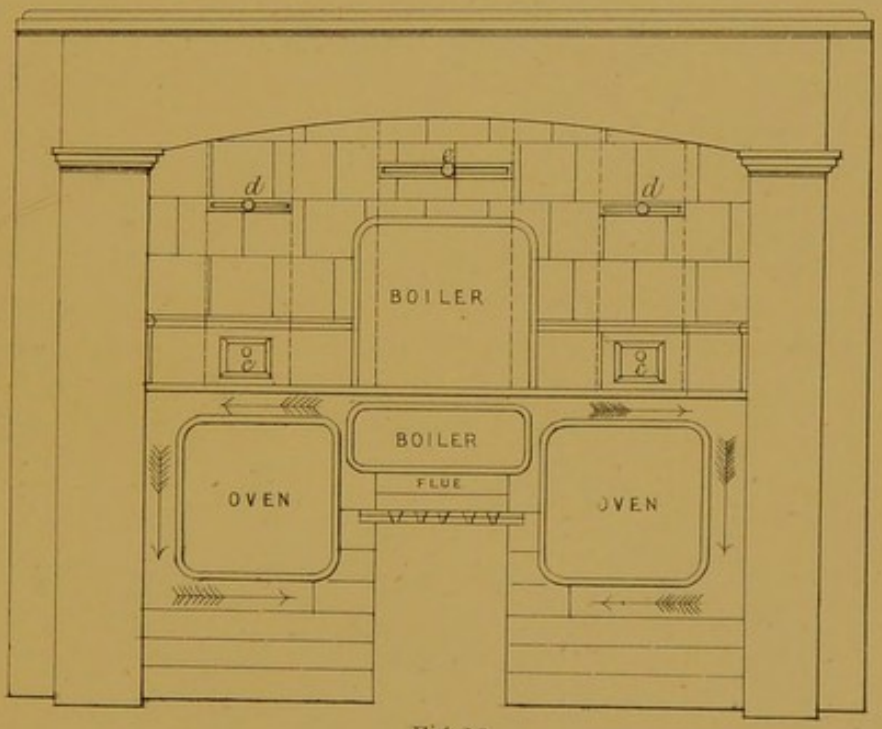


Fig 28

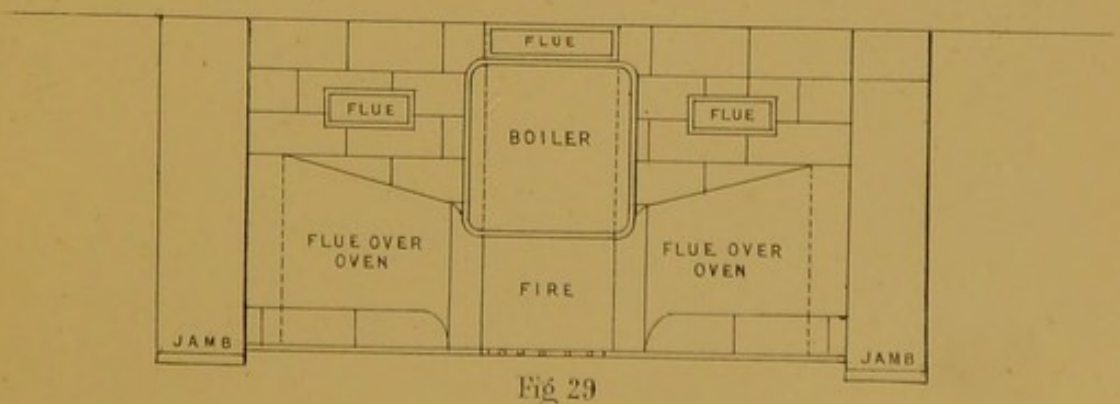


Fig 29

Figures 30 to 32.

Fig. 30. Horizontal section, showing the flues provided under the ovens.

a, *a*, projection formed in iron or brickwork to prevent the hot air which descends on one side of the oven from passing into the back flue without heating the bottom of the oven.

Fig. 31. Vertical transverse section, showing the vertical flue behind each oven.

c, soot door.

d, damper.

Instead of the register door a ventilating flue, Fig. 35, can be used for ventilating the kitchen.

Fig. 32. Vertical transverse section, showing the shape of the boiler and the flue provided underneath and behind it for the passage of hot air.

d, damper. The neglect of properly checking the escape of hot air by means of this damper causes great waste and impairs the general efficiency of the kitchener.

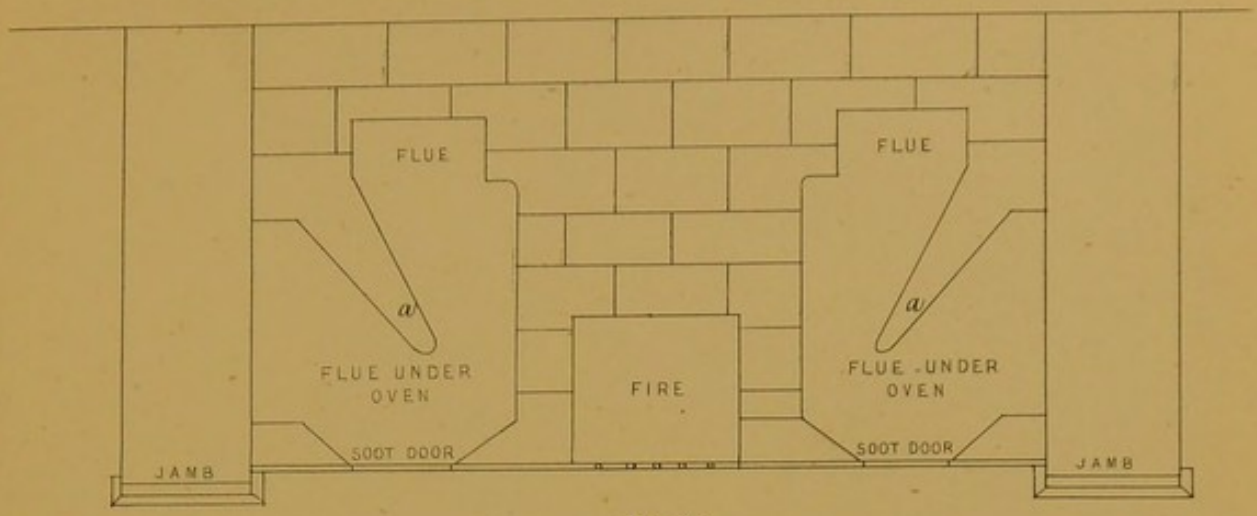
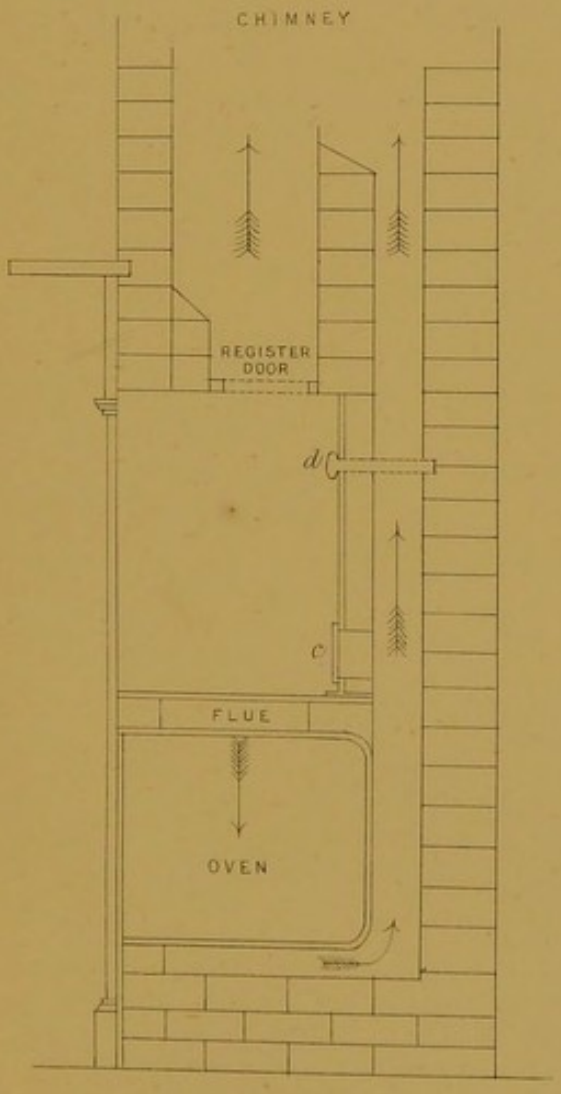

FLUE
FLUE
a
a
FLUE UNDER OVEN
FIRE
FLUE UNDER OVEN
SOOT DOOR
SOOT DOOR
JAMB
JAMB

Fig. 30.


CHIMNEY
REGISTER DOOR
d
c
FLUE
OVEN

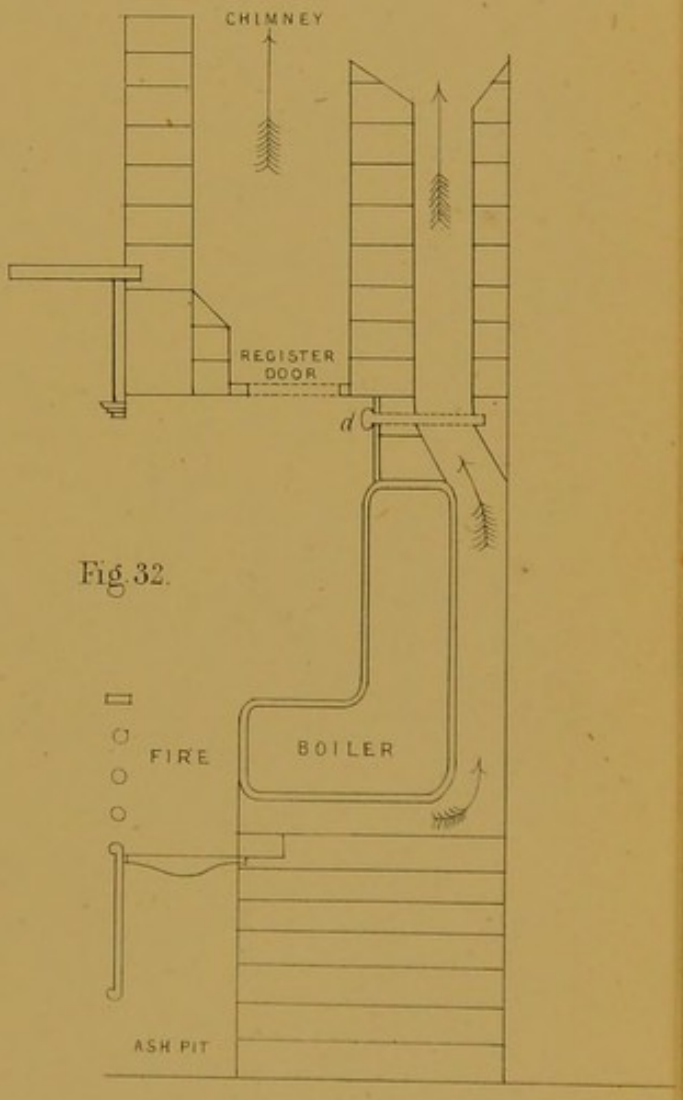

CHIMNEY
REGISTER DOOR
d
FIRE
BOILER
ASH PIT

Fig. 32.

Figure 33.

Section of a house with a perspective view of some of the arrangements.

a, kitchener with boiler for providing hot water to the upper floors.

b, cold water cistern fixed below the roof of the house.

c, hot water cistern fixed below the cold water cistern.

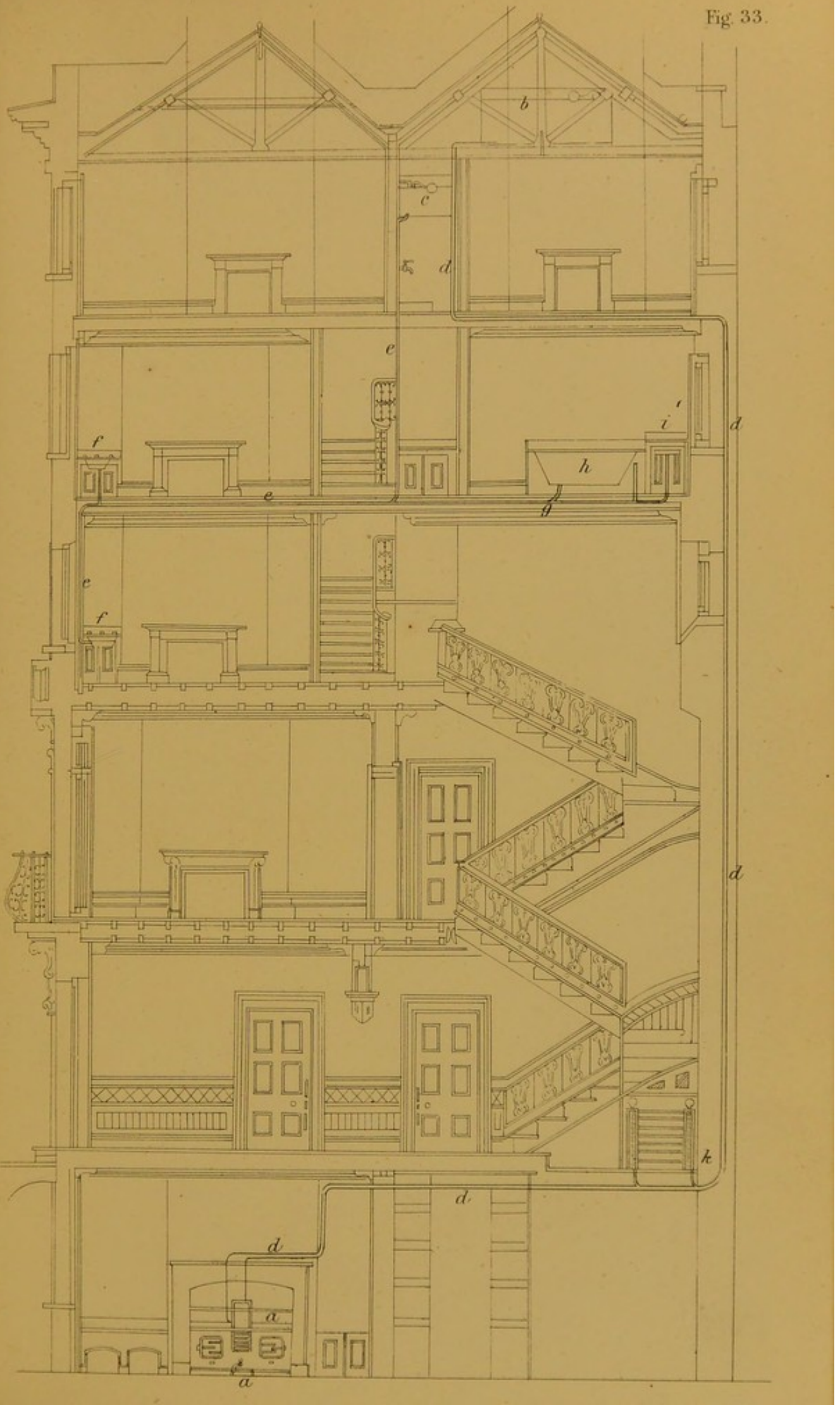
d, *d*, the ascending and descending circulating pipes which connect the boiler of the kitchener with the hot-water cistern.

e, *e*, *e*, branch pipe to supply hot water to the basins *f*, *f*.

g, branch pipe to supply hot-water to the bath *h* and the basin *i*.

k, hot water coil heated by the circulation of hot water, branch pipes being used to connect it with the circulating pipes *d*, *d*.

Fig. 33.



Figures 34 to 40.

Fig. 34. Brick bottom pierced with holes and enclosed by a rim of iron, to be used instead of the ordinary metal grate.

Fig. 35. Ventilating tube to be fixed over the fire-place of a kitchener.

Fig. 36. Sketch showing the external appearance of the fire-place of a kitchener, to which the principle of supplying coal from below is provided.

a, wheel in which a poker is inserted for the purpose of turning the wheel whenever it is desired to raise coal into the fire.

Fig. 37. Section showing how the body of coal is raised as it burns away from above.

b, lifting bottom.
c, lifting rack.
d, wheel.
e, poker.
f, ash-pit.

Fig. 38. Sketch of a superior and economical arrangement for cooking, in which a fire may be used either closed or open at pleasure, no rapid draught to the chimney is permitted, hot metal is dispensed with as much as possible, and glazed tiles are substituted for the purpose of confining the heat, and presenting a clean, cheerful, and temperately warm surface in the apartment. On the hot-plate surface various openings are shown, at which cooking utensils, protected by double covers on Count Rumford's system, can be introduced to be heated on the economical plan of actual immersion in the hot air which passes from the fire. The openings are covered up when not in use.

a, fire door.
b, door by which any ash is removed, and a supply of air to the fire is regulated.
c, oven, the door and outer surface of which is covered with glazed tile to confine the heat.
d, *d*, *d*, *&c.*, covers to apertures at which cooking vessels can be inserted to be immersed in the hot air which passes from the fire.
e, *e*, *e*, *&c.*, surfaces of glazed tile.

Fig. 39. Section showing how the hot air passes from the fire to the cooking vessels and the oven.

Fig. 40. Horizontal section showing the position of the boiler, *a*, behind the fire.

b, *b*, *b*, *&c.*, flues for the passage of hot air from the fire, which enable heat to be communicated to the whole exposed surface of the vessels inserted.
c, a descending flue by which the hot air on the right-hand side is made to pass under the boiler before its escape.

Fig. 34.

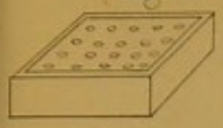


Fig. 35.

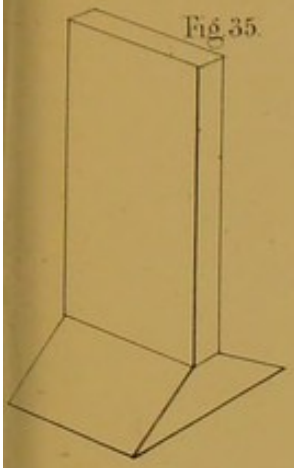


Fig. 36.

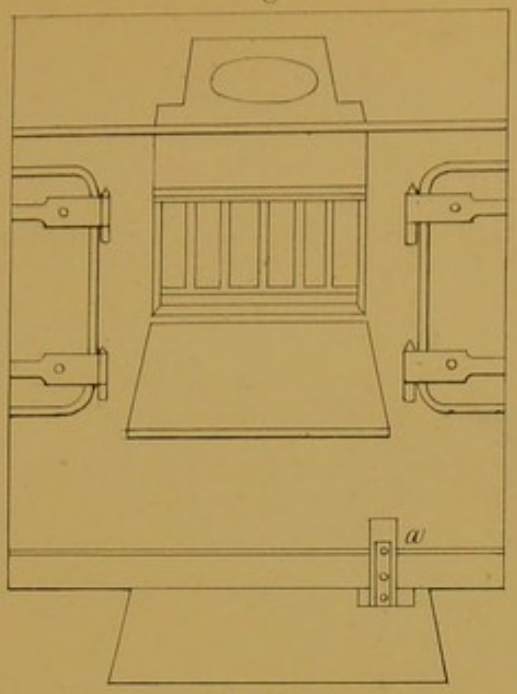


Fig. 37.

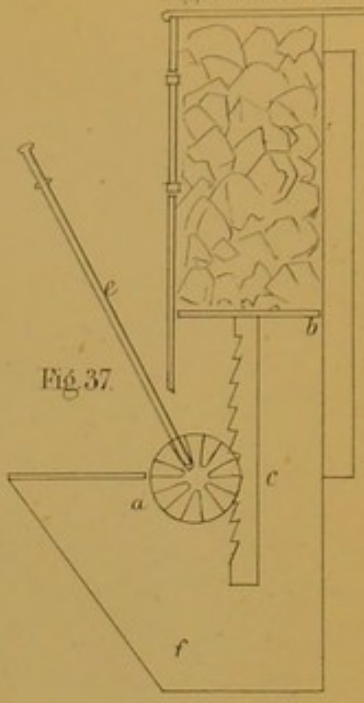
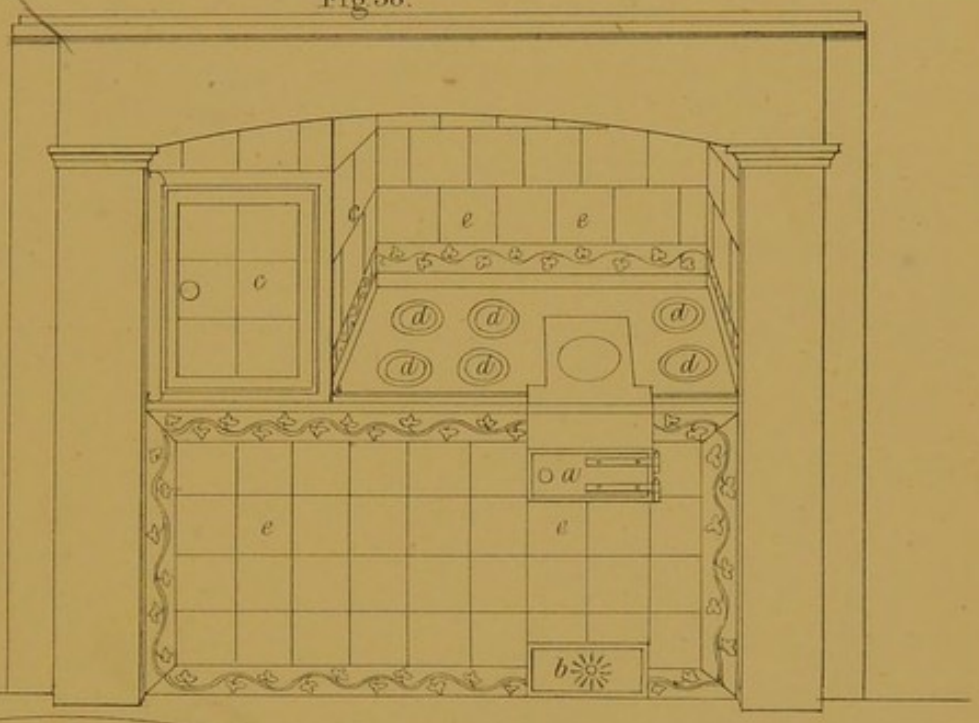


Fig. 38.



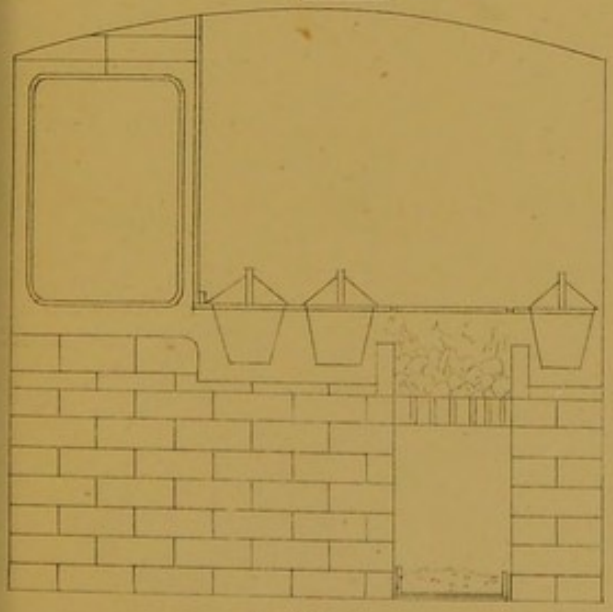
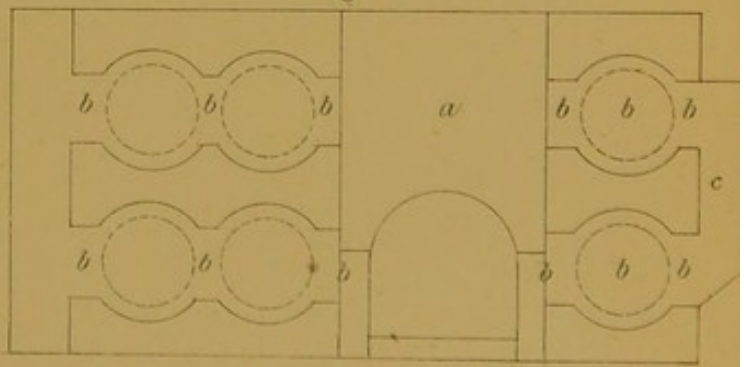


Fig. 39.

Fig. 40.



Figures 41 to 43.

Fig. 41. Sketch of an arrangement similar in principle to that shown in Fig. 38, but an a larger scale. In this as in the other, the fire may be used either closed or open at pleasure, no rapid draught to the chimney is permitted, hot metal is dispensed with as much as possible, and glazed tiles are substituted for the purpose of confining the heat and presenting a clean, cheerful, and temperately warm surface in the apartment. On the hot-plate surface various openings are shown, at which cooking utensils protected by double covers on Count Rumford's system can be introduced to be heated on the economical plan of actual immersion in the hot air which passes from the fire. The openings are covered up when not in use.

a, fire door.

b, ash door with regulator.

c, *c*, ovens for roasting or baking, the doors of which are covered with glazed tiles to confine the heat.

d, *d*, hot closets for warming plates, &c., heated by the hot air which passes over them. The doors covered with tiles to confine the heat.

e, *e*, *e*, *&c.*, covers on the hot-plate over the apertures at which vessels are inserted.

f, *f*, *f*, *&c.*, surfaces of glazed tile.

Fig. 42. A similar system to that shown in Fig. 41, but with two ovens for roasting or baking, one placed above the other, and both heated by a separate fire to that which heats the vessels in the hot-plate and which heats the boiler. As the fire to the ovens would only be lighted when the ovens were actually required to be used, it is believed that considerable economy would be effected by the use of a smaller fire for the boiling of water and for the other facilities of cooking.

Fig. 43. An arrangement in which the principle of division for the purpose of economy is carried still further. The fire in the centre is supposed to be of little more than sufficient power to cook vessels above and to heat the hot closets. The surplus heat from it should pass round the ovens in the left division, and round the boiler in the right hand division. The ovens would then require a small and very economical fire to be made underneath them when actually required for use, and the boiler would require the assistance of a small and very economical fire when the water was required to be boiling hot. On all other occasions the one fire would be sufficient.

Fig. 41.

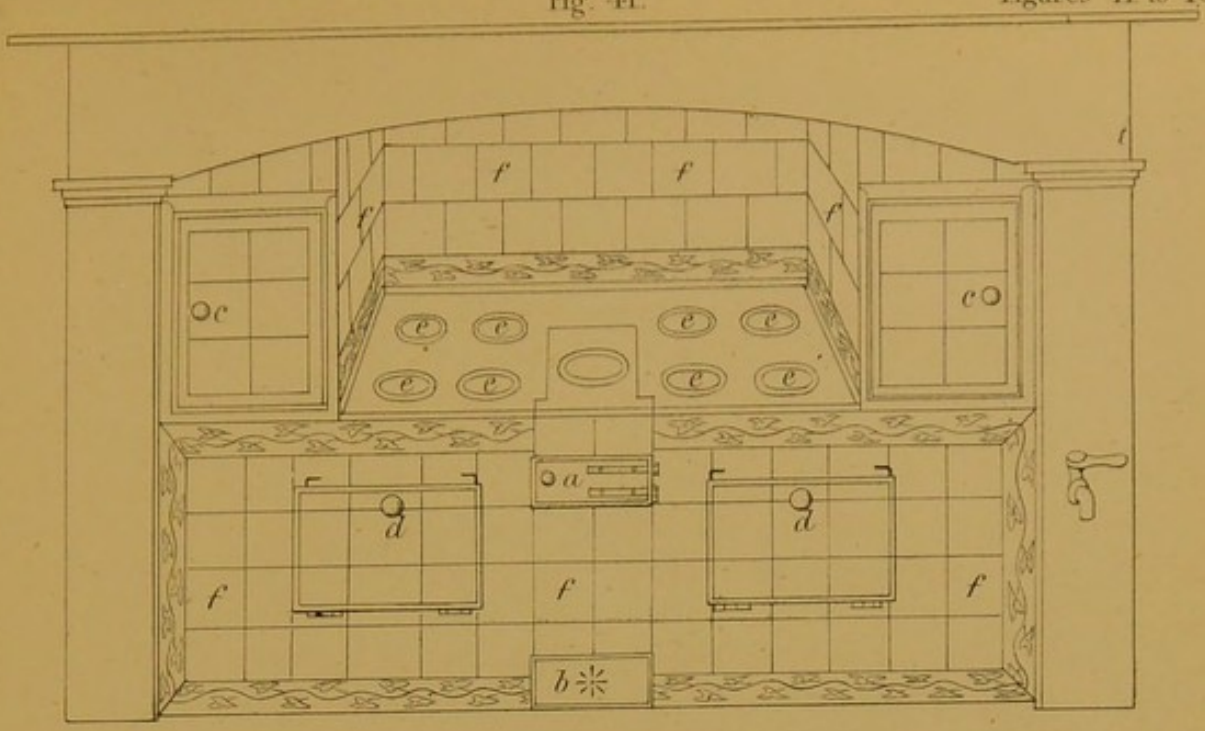


Fig. 42.

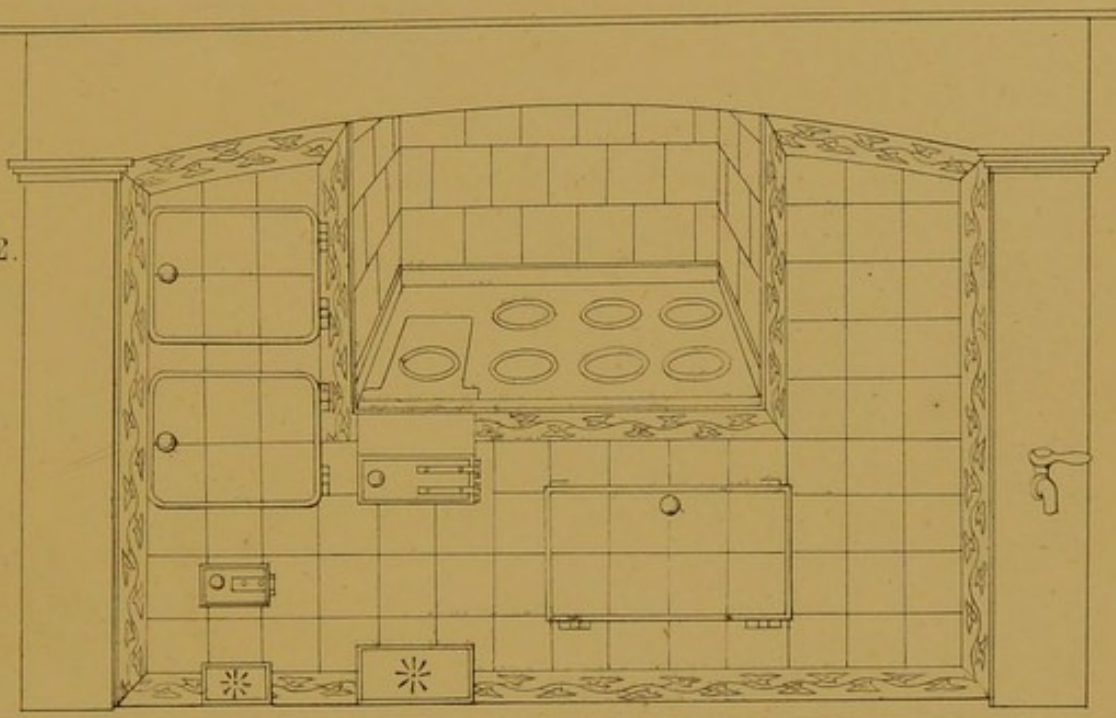
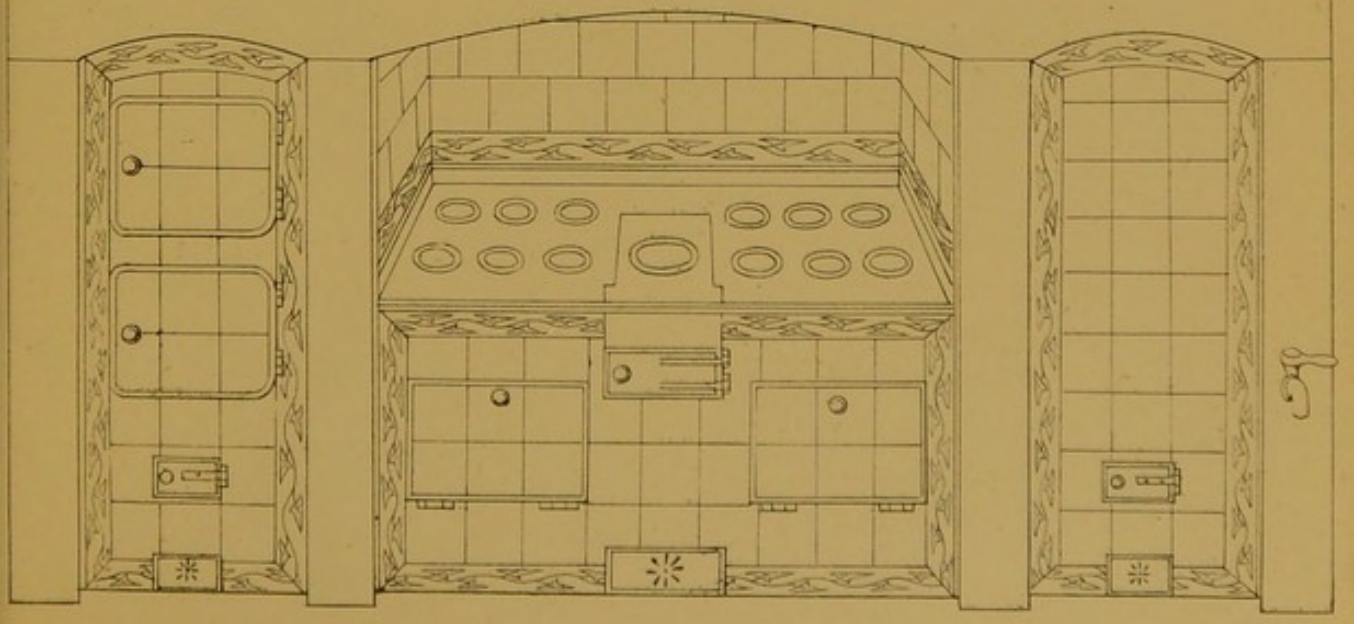


Fig. 43.



Figures 44 to 47.

Fig. 44. An American cooking stove. The fire is closed. The top forms a hot-plate, and the hot air is made to pass round every portion of the ovens except at the doors before its escape to the chimney.

Fig. 45. Norwegian cooking stove. The fire is closed. The top forms a hot-plate, aud the hot air passes round the oven before its escape to the chimney.

Fig. 46. Norwegian cooking stove on a larger scale.

Fig. 47. A gas cooking stove for boiling, stewing, or broiling over gas jets.

Fig. 44.

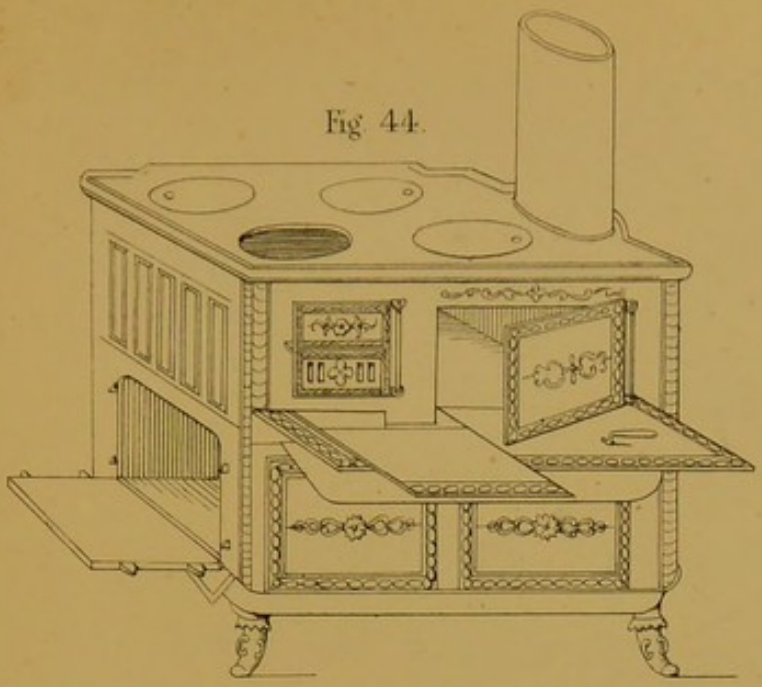


Fig. 45.

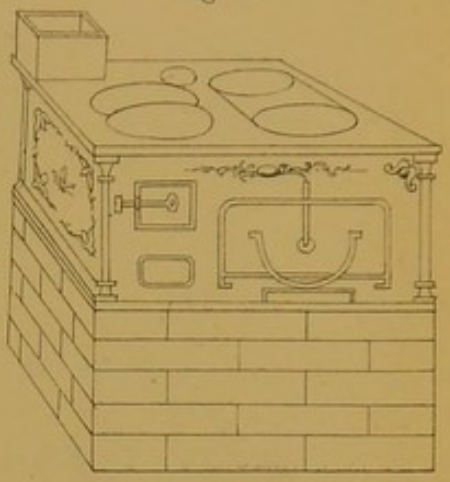


Fig. 46.

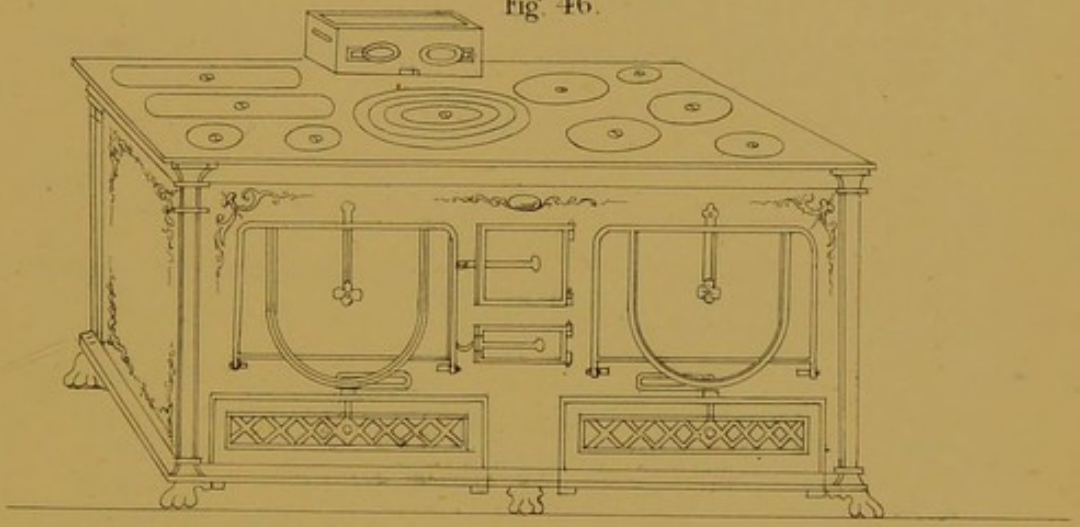
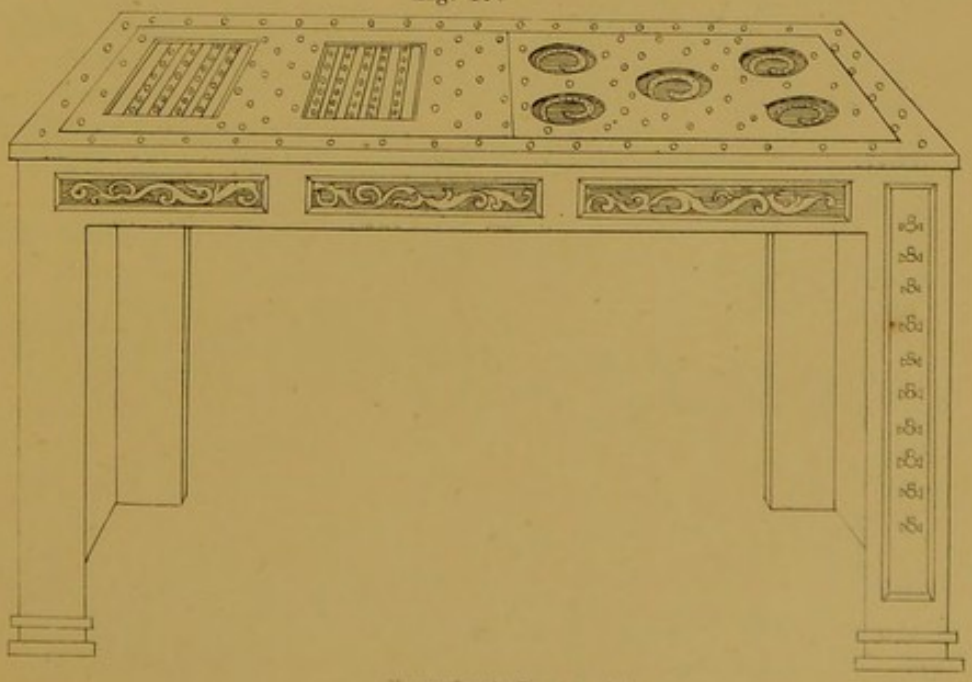


Fig. 47.



Harrison Brooks, Day & Son, Lith.


PARIS, 1855. FIRST CLASS MEDAL.
DUBLIN, 1865. PRIZE MEDAL.

LONDON, 1851. PRIZE MEDAL.
LONDON, 1862. PRIZE MEDAL.

FREDERICK EDWARDS & SON,

Stove and Kitchen Range Manufacturers,

MANUFACTURERS OF MEDIÆVAL GRATES AND FENDERS,

HOT-WATER ENGINEERS,

49, GREAT MARLBOROUGH STREET, REGENT STREET,

LONDON.

GRATES.

IMPROVED ECONOMICAL GRATES, constructed on thoroughly sound principles for economizing fuel, diffusing heat, and preventing inconvenience from smoke.

PORCELAIN TILE GRATES, in which iron is rejected in favour of fire-brick for the interior of the grate, and tiles or slabs in porcelain, encaustic or majolica ware, are used for the decoration. The prices of these grates allow of their introduction in any chambers whatsoever where a fire is required to be used.

IMPROVED INDEPENDENT GRATES and DOG GRATES, in very great variety of Mediæval and other designs, the interior of the grates being lined with fire-brick, and tile sides and tile hearths provided for the decoration of the fire-place.

IMPROVED FIRE-LUMP GRATES, specially adapted for use in Charitable Institutions, School Rooms, Work-houses, Railway Stations, Servants' Offices, &c.

IMPROVED SMOKELESS GRATES, adapted to prevent the formation of smoke, to economize fuel, to diffuse heat, to burn for many hours without attention, and to avoid chimney sweeping.

STEPHENS' & KING'S PATENT GRATES. Steel and Or-molu Grates with fire-lump interiors. Improved Sham Grates. Berlin black and fine cast Mediæval Grates with fire-lump interiors.

IMPROVED VENTILATING GRATES, for furnishing in the apartment a supply of fresh warm air. Captain Galton's Ventilating Grates.

STOVES.

PATENT GILL AIR-WARMERS, for warming the halls and staircases of dwelling houses and for warming churches, made of a capacity to heat from 3,000 to 60,000 cubic feet; and to burn with either ascending or descending flues, and through the night, if required, without attention.

PORCELAIN TILE PEDESTAL STOVES, with open fires, handsomely decorated with porcelain, encaustic or majolica ware, for use in halls, shops, cabins, &c. These stoves are now made at much less prices than formerly.

PIERCE'S PYRO-PNEUMATIC STOVES, with fire-brick interiors and warm air chambers, made to give a supply of fresh and wholesomely heated air.

DR. ARNOTT'S SLOW COMBUSTION STOVES, for use in halls and show rooms, where a fire is required to be kept perpetually burning. They require attention twice in the course of twenty-four hours only.

GOLDSWORTHY GURNEY'S STOVES, for use in churches and other public buildings.

COOKING APPARATUS.

GREATLY IMPROVED KITCHENERS, constructed with tiled doors and tiled surfaces, and specially adapted for economizing fuel, for effectually heating the ovens and hot plate, for enabling roasting to be done in the most unexceptionable manner in the roasting ovens, but in front of an open fire if desired; also for effectually ventilating the kitchen, and preventing the old inconvenience to servants of excessive heat.

STEAM COOKING APPARATUS, on very economical arrangements for cooking for from 100 to 1000 persons, and adapted for use in Hospitals and other Charitable Institutions, large Wholesale or Retail Establishments, Public Schools, Prisons, Workhouses, &c.

OPEN FIRE KITCHEN RANGES, of excellent manufacture. Smoke Jacks, Pastry Ovens, Steam Closets, Hot Plates, Stewing Stoves, Cottager's Cooking Stoves, Nursery Boiler Stoves, &c.

ENGINEERING.

WARM BATHS, erected with hot, cold, and waste pipes, hot water cistern and circulating pipes heated from the kitchen boiler, so that a bath may be had at any moment of the day. Hot water furnished, if required, by the same system, to wash-hand basins, housemaid's closets, sculleries; or made to circulate through coils of pipes for giving heat to a hall, a conservatory, or a billiard room.

HOT WATER CIRCULATION, for heating churches and other public buildings, and for conservatories; also for the halls, staircases and passages of large private residences, and for contributing heat, if required, to drawing room, dining room, library and billiard room, with handsome ornamental cases to cover the pipes.

LAUNDRY APPARATUS, erected for the entire operations of washing, drying and ironing the linen of large houses, and of public establishments. Washing Coppers, and Ironing Stoves of all kinds.

LIFTS, for Hotels and other large establishments; also on a small scale as admirably adapted to add to the convenience of private families.

LAVATORY APPARATUS, with the latest improvements, for Clubs, Restaurants, &c.

Messrs. EDWARDS & SON furnish Estimates gratuitously for the Erection of Works in any of the branches they have enumerated, and they include Carpenters' and Plumbers' Work if preferred. They send to any part of the country for the purpose of preparing Estimates and giving those who consult them the benefit of their experience and advice, and they guarantee that whatever they undertake shall be signalized by excellent workmanship and efficient action.

P. T. O.

MR. EDWARDS'S PUBLICATIONS

ON

WARMING AND VENTILATION.

OUR DOMESTIC FIRE-PLACES.

A New Edition, entirely re-written, enlarged, and adapted for popular reading, the additions completing the Author's contributions on the Domestic Use of Fuel and on Ventilation. By FREDERICK EDWARDS, Jun. Royal 8vo., with 149 Illustrations, and a Portrait of Count Rumford, 12s.

"It bears on every page the mark of careful research, and abounds to such an extent with useful matter that we should desire to see it studied and its contents brought into actual practice by all those who are in any way concerned with the important branch of domestic economy on which it treats."—*Chemical News.*

SMOKY CHIMNEYS, THEIR CURE AND PREVENTION.

Sixth Edition, revised, royal 8vo., with 40 Illustrations, price 3s. 6d.

"Attention to the facts Mr. Edwards has indicated will save landlords and householders a deal of trouble, expense, and anxiety."—*Building News.*

THE VENTILATION OF DWELLING HOUSES,

And the UTILIZATION OF WASTE HEAT FROM OPEN FIRE-PLACES. Royal 8vo., with 107 Illustrations, 10s. 6d.

"A book which, by its clear and concise language and modest bulk, is almost a marvel in this book-making age.—*Examiner.*

THE EXTRAVAGANT USE OF FUEL IN COOKING OPERATIONS,

With an Account of Benjamin Count of Rumford and his Economical Systems, and numerous Practical Suggestions adapted for Domestic Use. Royal 8vo., with 47 Illustrations, 5s.

"Mr. Edwards writes excellently, without technicality or obscurity, and may fairly say that he has done his part towards making the subject intelligible to unscientific persons."—*Pall Mall Gazette.*

LONDON: LONGMANS, GREEN & CO., PATERNOSTER ROW.

BY THE SAME AUTHOR.

Fifth Edition, revised and enlarged, with many Illustrations, price 3s. 6d.

ON SMOKY CHIMNEYS, THEIR CURE AND PREVENTION.

"We cordially recommend this successful attempt to teach a few plain, but too often neglected, rules. The great charm of the treatise is its conciseness and practical usefulness. Attention to the facts Mr. Edwards has indicated in it will save landlords and householders a deal of trouble, expense, and anxiety. The work will serve as an excellent companion to the book, by the same author, on 'Our Domestic Fire-places,' which we see has also reached a second edition."
BUILDING NEWS.

In royal 8vo., price 10s. 6d., with 19 Plates,

ON THE VENTILATION OF DWELLING HOUSES,

AND THE UTILIZATION OF WASTE HEAT FROM OPEN FIRE-PLACES.

"A book which by its clear and concise language and modest bulk, is almost a marvel in this book-making age."
EXAMINER.

"Mr. Edwards has further increased the utility of his work by the numerous lithographic drawings with which it is illustrated. They assist in demonstrating his suggestions with admirable clearness, and it may truly be said, that if any practicable results should ensue from his plain teaching he will have conferred a great boon on society at large by this excellent publication."
MORNING POST.

"It cannot be denied that if practical as well as theoretical knowledge entitles a man to respectful attention, Mr. Edwards can put forward unexceptionable claims; and if ever anybody brought to bear upon a written work hearty earnestness and diligent research, Mr. Edwards seems to have done so." "His essays are written in an impartial spirit, and in the manner rather of an artist than of a purveyor of grates; and they contain so much in the way of narrative and anecdote that they are scarcely less interesting than useful."
ILLUSTRATED LONDON NEWS.

OUR DOMESTIC FIRE-PLACES,

A TREATISE ON THE ECONOMICAL USE OF FUEL AND THE PREVENTION OF SMOKE.

The publication of the third edition of this book is postponed till the Autumn.

In Demy 8vo., price 2s. 6d.

ON LETTERS-PATENT FOR INVENTIONS,

BEING A CONSIDERATION OF THE EXPEDIENCY OF ABOLISHING THE PRIVILEGE OF SPECIAL PROTECTION TO THE INVENTOR.

"In a very clear review of the operations of the 'Patent Laws,' Mr. Edwards contends for their total abolition."
WESTMINSTER REVIEW.

"It is the labour of an earnest, thoughtful, liberal-minded man, whose views, largely in advance of the time, are sure ultimately to prevail."
SOCIAL SCIENCE REVIEW.

LONDON: LONGMANS, GREEN & CO., PATERNOSTER ROW.

RECORD OF TREATMENT, EXTRACTION, REPAIR, etc.

Pressmark:

Binding Ref No: 4348

Microfilm No:

Date	Particulars
July 01	Chemical Treatment
	Fumigation
	Deacidification
	Renaissance HA liquid
	Lamination
	Solvents
	Leather Treatment
	Adhesives
	Remarks